

June 1, 1959

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Aviation Week

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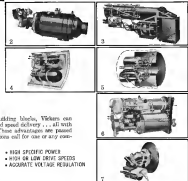
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AVIATION CALENDAR

- June 13—International Meeting and Airshow Exposition, American Rocket Society, 40 Corona Blvd., San Diego, Calif.
June 13-15—1967 Telemetry and Test Methods Symposium, Los Angeles, Calif. For information: Engineering Education, University of California, Los Angeles 24, Calif.
June 13-21—2nd French International Air Show, Le Bourget, Paris, France.
June 15-25—International Conference on Information Processing, UNESCO 4th, Paris, France.
June 14-16—Symposium Meeting American Society of Mechanical Engineers, Chase Park Plaza Hotel, St. Louis, Mo.
June 15-17—Industry, Vehicle and Space Conference, Mission College Hotel, De Anza, Calif. Sponsored: American Rocket Society and Space Arms.
June 16-18—National Science Meeting, in honor of the Astronautical Society, Air San Diego Hotel, Los Angeles, Calif.
June 17—London Meeting, Aerojet and High Temperature Jet, Ford Research Naval Air Station, Dayton, N. Y.
June 18-20—1967 Annual Meeting Institute of Navigation, 17 & Madison, New York, N. Y.
June 21-23—San Francisco General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Chicago Hotel, Seattle, Wash.
June 22—San Francisco General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Seattle, Wash.
June 23-25—1967 Meeting, American Institute of Manufacturers, San Francisco Hotel, San Francisco, Calif.
June 24-26—1967 National Symposium, Naval Academy, Dayton, Ohio.
June 26-28—1967 National Symposium, Naval Academy, Dayton, Ohio.
June 29-July 1—1967 National Convention (Continued on page 6)

AVIATION WEEK Including Space Technology

June 3, 1968
Vol. 76, No. 22

Aviation Week is a national event in America. It is the only time when the entire aviation industry, from the smallest local airport to the largest international airport, comes together to celebrate the achievements of the industry. It is a time when the industry can showcase its products and services, and when it can learn from the experiences of others. It is a time when the industry can come together to discuss the challenges it faces, and when it can work together to find solutions. It is a time when the industry can celebrate its successes, and when it can look forward to the future with confidence.

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AVIATION WEEK, June 1, 1968



quality control of WELDMENTS and COMPONENTS by Lavelle

Quality control of precision sheet metal components for jet engines, missiles, air frames and similar and producing demands the total resources of qualified men, methods and machines. At Lavelle, experienced craftsmen use a variety of inspection techniques and equipment at every stage of production... from tool control to final piece inspection... to maintain quality control of critical parts to exacting specifications.

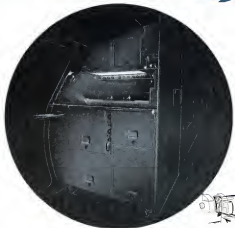
Lavelle specializes in producing weldments and assemblies made of titanium, aluminum, magnesium, stainless steel and nickel alloys. X-ray, Zigzag, and Magnaflex methods of non-destructive inspection are controlled and used to control material and weld quality. Close supervision by Lavelle inspection specialists assures consistent component quality... at a cost related to your standards.

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WHAT'S THE NEWEST? Above illustration, with small inset drawing, demonstrates the new removable Buffet System concept. While sections easily interchange, to assure rapid food restocking. This and many other designs are available from Weber . . . a pioneer in airline interior equipment.

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Partial view of a 18" x 18" x 30" low temperature test chamber built by the Weber Division of Wyle Manufacturing Corp., St. Joseph, California. Bulk liquid PURECO CO₂ gasizes the chamber space to -118° F. or colder.

PURECO CO₂ puts the freeze on Wyle test chambers

Inside this low temperature chamber at Wyle Laboratories, missile and aircraft mobile ground support test units are subjected to temperatures plunging well below zero.

The best refrigerant for this important test job is PURECO CO₂ in bulk liquid or solid form ("DRY-ICE"). It can be ACCURATELY CONTROLLED, is MAINTENANCE-FREE, CONVENIENT, RELIABLE and LOW IN COST.

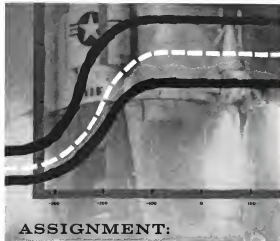
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ASSIGNMENT: CRYOGENICS

How Lukens Application Research helps you find the right steel plate for the job

If your assignment is designing equipment for extreme low temperature service—our Application Engineering staff can help you. They research problems of every description from the design stage right through to how the equipment has performed for years after its installation.

Mild steel components and liquefied gas tanks would be disastrously unsuitable to cracking if made from ordinary steel. Requiring equipment experts for such applications, Lukens engineers began years ago to study the performance of nickel bearing alloys in a variety of low temperature equipment. Result: a broad understanding of metal behavior at various low temperature levels.

Examples: In the storage of liquefied oxygen, a tank of Nine Nickel steel provided

more than eight years of trouble-free performance. Suitable to make 316°F service the steel showed no signs of cracking when removed for inspection. Its fragid chambers for testing high altitude aircraft 3 1/2 percent nickel steel is striding up well under pressures as high as 3,000,000 pounds. And in such locomotives operating at temperatures as minus 56°F, an rugged monomer rods, main shafts of Lukens "T-4" steel have required no maintenance whatsoever.

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continuous readings of distance to go
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TNC-50 COMPUTER



PRECISION. GPL's new Trans Navigation Computer provides direct outputs of distance to destination and distance left or right of track. Designed to function with ARINC and other Doppler systems, and any existing aircraft heading reference, the TNC-50 provides additional outputs for flight director, autopilot, and instruments.

REALISTIC APPROACH. Utilizing the concept that a flight plan is composed of one or more segments, the TNC-50 provides continuous progress displays of distance and direction along these segments, thereby eliminating complex latitude-longitude instrumentation.

ONE REPAIR. A compact accurate computer providing continuous aircraft and command information to the pilot, and steering information to the automatic flight controls. Write for further data on the TNC-50 and GPL's new ARINC Doppler sensor, RADAR-500.



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Republic High-Performance

In the Coastr 880—the world's fastest jet airliner—speed, economy, and medium-range operating requirements dictated the use of thousands of pounds of high-performance metals. Working closely with design engineers, Republic Steel supplied:

TITANIUM to increase strength-to-weight ratios . . . permit lighter weight with increased strength.

ENDURO® STAINLESS STEEL to increase heat and corrosion resistance at elevated temperatures.

ALLOY STEEL to increase strength of major structural components . . . provide an extra margin of "built-in."

Republic has pioneered in the development and production of new metals to increase strength, resist heat, reduce weight. With constantly expanding research as well as production facilities and capabilities, Republic is the nation's largest producer of high-performance metals—tin plate, stainless, and alloy steels.

Let us help you find the most advantageous uses of these metals in your project. Return the coupon for complete information without obligation. Please indicate if you would like a Republic Metallurgical Specialist to call.



TITANIUM STEEL IS USED IN CRITICAL AREAS OF THE 880's method for steel horizontal rib-type where this alloy is incorporated through solution-treating of the metal. Use of Republic ENDURO Stainless Steel increases strength and heat resistance parallel flanges, lighter weight. Types 304 and 316 are readily formed into desired shapes by cold forming, drawing, and bending operations. Metal coupons for complete details.

REPUBLIC



World's Widest Range of Standard Steels

Metals for the 880



IN SLAB END-PORTION: rear engine mount "breakers" frame . . . of alloy plate, pressure-casting steel—after the powerful General Electric Co. 405-3 engine. After break after approximately high strength to weight ratio with the highest strength index. Under treatment to heat treatment course complete step to laying new engine, the heat, was-molten surface. Send for additional information.

REPUBLIC'S NEW HIGH-TITANIUM POWER, TYPE 880-80.

Is ideal for service of High Pressure components. Provides minimum tensile strength of 60,000 psi at 6-6 density as welded . . . 800,000 psi after heat treatment. Less than 0.04% shrinkage from the size at 6-4 density. Available in quantities up to and including 12 tons or multiples. Can be used with existing, operating equipment. Steel coupon for technical data sheet.



ALSO ONE ENGINEER 880 the 11 hour scheduled weekly assembly—1275 pounds per month, 30-5 pounds per engine (210 pounds) and may use steel—20 pounds per month, 210-5 pounds per airplane and 210-5 pounds per engine. Also 400 pounds per month—400 pounds per month. 1945 weekly per engine. Republic supplies a major portion of the 880 pounds of titanium steel from the steel 880.

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<input type="checkbox"/> Type 4340 Steel	<input type="checkbox"/> Type 4340 Steel
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THE G 91 T A NEW FIAT JET-TRAINER

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Energy fuel from the airplane's tanks—which automatically ignites with hydrogen peroxide—these engines have full stop and restart capability.

More value for taxpayers' money

The auxiliary rocket engine gives present aircraft superperformance capabilities at a relatively low cost. It provides the increased speed and maneuverability that could spell the difference between the success or failure of an intercept mission. Almost any existing jet aircraft, as well as those now on the drawing board, can be adapted readily for AR engines.

Looking forward to tomorrow

Beyond a doubt, rocket power has a leading role in the Free World's future. Rocket-propelled airplanes, such as the X-15, will pave the way for man's entry into Outer Space. The multi-mechanized-thrust systems that are now under development at Rocketdyne will be man's means to explore interplanetary space. Yet meanwhile, these rapid advances in rocketry can add great strength to America's present deterrent arsenal.

WHAT KIND OF ENGINE FOR A SPACE-JEEP?

It takes a unique engine to jockey a space-jep in for a landing on an orbiting space station—one that will give a space pilot instant control and precise maneuverability.

Such an engine is the fully controllable rocket engine—ideal for space travel yet so easy to operate as an automobile engine.

The rocket engines are ready now

Although the space-jep is still a gleam in an engineer's eye, the controllable rocket engine is available now...and has immediate application for exciting tomorrow. The pilot of a plane with auxiliary rocket power can switch it on for sudden, swift acceleration at high altitudes...the aircraft's air-breathing turbojets supply power for ordinary dash operations. This is the second-power jeep: Since World War II several

ground-power concepts have been developed in foreign countries, including Russia, France and England.

Extra power for today's aircraft

Rocketdyne already has designed, tested, and manufactured rocket engines for mixed power applications. The AR-1 rocket engine is a liquid-propellant system, as are the large power plants for the Atlas, Titan, Jupiter, and Redstone ballistic missiles. The AR-1 passed stringent flight tests as a supplementary power plant on modern jet aircraft. Substantial improvements over several years ago speed and 50,000-foot altitude capabilities were demonstrated in more than 100 test flights.

The AR-2, second in a series of four rocket-engine models developed by Rocketdyne, is a fully-throttleable engine that provides varied thrust



TITLE ENGINE OF ROCKET POWER
The liquid-propellant AR rocket engines are "cubic thrust" at Rocketdyne's field laboratory to measure thrust and performance.

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FOR OUTER SPACE

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A DIVISION OF NORTH AMERICAN AVIATION, INC.

Ever try threading five needles at once?



Cable has, electronically speaking. And for greater precision a segment of the five-target Cable MOPTAR which will be used by the Federal Aviation Agency to evaluate experimental air-traffic-control systems. MOPTAR (Multi-Object Phase Tracking and Ranging), an omni-directional system requiring no tracking equipment, provides steadily accurate real-time position data. MOPTAR can be expanded to track hundreds of objects simultaneously with this same

accuracy. The FAA installation will monitor other systems in tests at the new National Aviation Facilities Experimental Center near Atlanta City. It's a new use for Cable's Space Age tracking systems developed under the forward-looking sponsorship of the United States Air Force. Now MOPTAR finds a secondary application in helping solve the problems of air navigation, an application that will lead to greater safety in the traffic lanes of the sky.

MOPTAR



Tracking system by Cable...reliable precision system with Space Age capability...find applications in air traffic control and, through the multiple-target potential of MOPTAR, in securing the free-potential of America's guided missiles.

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FAST, SMOOTH, DEPENDABLE

Fast, smooth, dependable... that's how you Conquest 280 and the B.F. Goodrich Chladder De-Icemat give you the enjoyment of this new-onion primer.

Freezing ribbon type electrical heating elements with built-in temperature sensor are sandwiched between layers of main-impregnated glass fabric. Then they are molded into a single unit and clipped with a stainless steel skin 80-foot sections bonded to empennage leading edges of the Conquest 280 from a smooth, angled airfoil.

B.F. Goodrich Chladder units reduce the possibility of ice-throwing, retrofit—can power consumption to 15-18 watts per square inch by cycling small sections one at a time. And lightweight B.F. Goodrich Chladder De-Icemat are designed to increase dependability, despite external impact damage.

B.F. Goodrich Chladder De-Icemat are available in variety of various thicknesses with power devices to meet your specific needs. B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Dept. AWP-60, Akron, Ohio.

B.F. Goodrich aviation products

EDITORIAL

Contracting With NASA

(The contracting policies of the National Aeronautics and Space Administration have they will be administered under the clauses provided for industry contract, are becoming increasingly important. In its Fiscal 1993 and 1990 budgets, NASA has allocated \$600 million of an \$800 million total for contracting with industry and research institutions. Please check the agency will follow in its contracting with industry but work by Ernest W. Brockett, head of its Procurement and Supply Division, is a speech before the New York State Society of Certified Public Accountants. Because of its interest in industry and the added detail supplied by Mr. Brockett, Avionics West is reproducing below significant portions of the speech.)

Some of you are now wondering "How can our company get a contract?" I will tell you about NASA's policies of procurement which may be at least a partial answer to your question. Procurement is done at all the NASA laboratories as well as at its headquarters in Washington.

NASA is under the same statute for procurement as the military departments, the Armed Services Procurement Act of 1949. Most of our larger research and development contracts are made with the same type of contract as the Army, Navy or Air Force. Also, where one of these departments has a contract administration organization in a contractor's plant in which we place a contract, we are asking that department to administer our contract.

You will find the clauses of NASA's contracts are the same for the most part as in the ASPR in the Army, Navy or Air Force contracts. Also, with minor exceptions, the same system of contract administration will be followed. This makes it simpler for you, the contractor, and saves any duplication of government work.

There is one difference in NASA contracts which should be noted and that is in the patent rights clause. The ASPR clause provides that the government receives a royalty-free license to any invention conceived or actually reduced to practice in the course of performing work under a government contract. However, title to such a patent is held by the contractor.

Contractors are asked to submit the same types of cost breakdowns and cost information when we negotiate a contract which they submit to the relevant department for these procurements. We, at times, will ask one of the military departments to furnish an analysis of these costs. We also have a cost audit in the department which will analyze costs in other activities. The contract cost principles found in Section XV of ASPR are generally being followed. Where one of the military departments is administering a contract for NASA, they will generally also furnish audit service.

However, any dispute on the allowability of an item of reimbursable cost, or any other dispute under the dispute clause of our contracts will be determined by the NASA procurement contracting officer. An appeal review with a dispute will be referred to a NASA Board of Contract Appeals rather than the Armed Services Board.

At the present time, and for some time to come, we can foresee no substantial production contracts to follow NASA's research and development contracts. This

might seem to discourage contractors from being interested in such contracts when the total dollar for it is limited and they cannot plan on getting a more substantial profit to be followed on production contract. This has not been our experience. Companies apparently feel that there is much to be gained by getting into the new field of space work.

The Space Act provides, in part, "To the maximum extent practicable, and consistent with the accomplishment of the purpose of this act, such contracts, leases, agreements and other transactions shall be allocated by the administration in a manner which will enable small business concerns to participate equitably and proportionately in the conduct of the work of the administration."

We intend to follow out that provision and are setting up an alternative small business program.

We have been asked whether NASA intends to adopt the military department's concept of procurement, which is used by the military departments to some extent. In a systems concept, a major planning activity is a complete program with one contract. This would include support equipment, training aids, spare parts and other items so that we can hold one company responsible for the complete working of the entire program. The alternative to this is for NASA to procure various items, or segments, separately from different contractors and integrate and assemble them ourselves.

Generally speaking, NASA is not adopting the systems concept. However, in certain critical programs where time is of the essence, to ensure success we may find it necessary to look to one contractor for complete integration and responsibility.

We believe you will find certain differences, perhaps advantages, in doing business with NASA compared with some of the other government agencies and departments, including the Defense Department. The NASA procurement organization is small and it is able to place its contracts with a minimum of delay and overhead. Both the contracts for development of the high thrust engine with North American Aviation and the space capsule contract with McDonnell Aircraft, two of our largest and most extensive procurements, were placed within three months from the time the procurement cycle started. Some of our other procurements have been completed within 30 days which include organization, contract drafting, execution, review by a contract reviewer, approval and distribution.

Thus far, most of our contracts for research development have been cost-plus-fixed-fee contracts, and I believe they will continue to be of that type for some time to come. When we are buying things with no past cost experience, it isn't fair to either the contractor or the government to attempt to fix a price because the contractor runs into unforeseen difficulties which cost him far more than he anticipated, or if he places contingencies in his price, it could mean raising the government more than a fair amount. Lack of cost experience so that a fair target price or target estimated cost contract is fixed is why we are not using incentive-type contracts...

Don't miss it!

Be sure to see the working models of the new
Kiddie hot and cold gas servo systems at
the Western National Astronautical
Society Exposition of the
American Rocket Society
at the El Cortez Hotel
in San Diego

June 9 to 11

Booth

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Kiddie hot and cold gas servo systems can be tailored to fit a wide range of applications. Illustrated above, rocket guidance control. They are low in cost, light in weight. Kiddie gas servo systems have low current and gas consumption, have few moving parts, and are extremely reliable. They operate at temperatures exceeding 1600° F. Kiddie's hot and cold gas servo system components have been developed, tested and are now on the shelf. If you have a problem involving servo valve systems, write for complete information to Kiddie today. Chances are we already have the answer.

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Procurement Legislation

Senate Armed Services Committee is expected to begin hearings shortly on comprehensive military procurement legislation. A subcommittee to look off the hearings was named last week. It consists of Sen. Strom Thurmond (D-S.C.), chairman; Sen. John Stennis (D-Miss.), Sen. Sam J. Ervin (D-N.C.), Sen. Howard Cannon (D-Nev.), Sen. Leavitt Saltzman (R-Minn.) and Sen. Prescott Bush (R-Conn.). The two key issues are:

- Whether a single source manager and a single prime contractor should be designated for weapons system projects. This is provided in legislation sponsored by Saltzman and opposed by the Defense Department (AW May 15, p. 31).
- Whether competitive negotiation should be encouraged and price cost studies with subcontract bid procurement, which was just a preferred status. This is provided in Saltzman's version, as well as separate measures introduced by New York's entire 44-member congressional delegation.

BOAC Tokyo Bid

Watch for a White House announcement granting a foreign air carrier permit to British Overseas Airways Corp. authorizing the airline to include Tokyo on its transpacific route. Although the Civil Aeronautics Board decision will not be announced publicly, said Transport Commissioner says the foreign air carrier permit, Airworthiness has learned that the five-member Board voted unanimously to support BOAC in its petition to ship to Tokyo as part of its expanded world route. The decision is a reversal of December 1965's recommendation to deny BOAC its application (AW April 27, p. 38).

Killion Returns to M. I. T.

Dr. James B. Killion, Jr., special assistant to the President for science and technology until November, 1977, resigned last week to return to Massachusetts Institute of Technology as chairman of the M. I. T. Corp. Killion, whose resignation became effective in mid-July, will be succeeded by George B. Kistiakowski, Resonance chemistry professor at Harvard University and chief of the engineering division of the Los Alamos Laboratory in 1944-45. President Eisenhower said he was accepting the resignation of Killion, who came to the post while serving as M. I. T. president, said "very sincere regret."

Space: Who's on First?

As exchanges of letters between the Senate Space Committee and the Defense Department have reduced the thrum of the U.S. military space program, and put who is directing it if there is a firm program.

Ray W. Johnson, director of Defense Department's Advanced Research Projects Agency, told the Subcommittee on Governmental Organization for Space Activities in March that Defense had a firm military program which he offered to make available to the Subcommittee headed by Sen. Stuart Symington (D-Mo.). He also noted that he was in charge of the military space program.

Sen. John Stennis (D-Miss.), chairman of the NASA Authorization Subcommittee, in a letter addressed to Defense Secretary Neil McElroy May 7, asked for copies

of the program presented to Johnson. The answer to the Senator's request was signed by Herbert T. York, director of Defense Research and Engineering, who has tight reins over research and development spending (see p. 31). York said the program requested "should not be considered a firm military space program but rather a program of military space program planning which serves to evaluate the possibilities that could be realized over the next eight years if it is determined that those programs should be pursued after consideration of our total defense requirements."

Tupolev to U. S.?

Richard Harter, former Air Force Assistant Secretary for Research and Development whose appointment as Assistant Administrator of the National Aeronautics and Space Administration becomes effective today, invited Soviet aircraft designer Andrei Tupolev to visit U. S. aircraft facilities and research facilities but with during a reception at the American embassy in Moscow.

Tupolev, who introduced the lightweight extended nose by Glenn L. Martin, Orlando Wright and Donald Douglas when he visited the U. S. in 1956, and he would be delighted to go under any circumstances. American Airlines President C. B. Smith told Tupolev that Americans would provide him with most-in-kind transportation.

As a follow up, it is expected that Tupolev will receive a formal invitation from Washington. Harter is in Moscow with 14 other aviation officials as members of the U. S. delegation to the annual meeting of the Federation Aeronautique Internationale. This is the second U. S. aviation group in three years to visit Russia. Over the same period, an Soviet aviation delegation has been generated by the State Department to visit the U. S.

Rickover: Freedom of Speech

Vice Adm. Hyman G. Rickover, assistant chief of the Bureau of Ships and prime mover in Navy's nuclear submarine efforts recently explained to the House Subcommittee on Appropriations the ways and means of serving on Capitol Hill without the loads of science and Defense Department restrictions in what opinion are to be expressed and how they are to be expressed.

Asked if he was "hushabout" in director in his testimony, Rickover replied:

"I have never followed an directive in testifying to Congress. Once one of my senses could not be better I was due to testify and told me what my policy was."

"I said, 'Fine. That was very good. When I testify I will say that this is what you told me to do.'"

"He said, 'Oh, no, you mustn't do that.'"

"I said, 'That's not an answer.'"

"Since that time I have never been disturbed."

Rickover later posed his point when asked what he thought of a Navy Fiscal 1980 request-and said it has been guiding successfully for a conventional-pressed course.

"You know damned well that to have an unbalanced ship is stupid. You know that. I am not even sure of the committee knows that. I do not care what arguments are given to you. What is the purpose of having a ship-what is the purpose of having an weapon of war that is not the best? Whom are you fooling?"

—Washington staff



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Monkeys Survive Jupiter Flight

Cape Canaveral, Fla.—Three ground sloths and a chimpanzee apical monkeys were successfully recovered late last week after being fast 1,500 mi. downrange from the Air Force Missile Test Center in a spooly tested in the nose cone of an Army Jupiter HSRM.

National Aeronautics and Space Administration which sponsored the experiment, said both animals apparently survived during the 27 min. flight which reached a maximum altitude of 300 mi.

The 250 lb. spooly, which contained two other bioastronaut experiments, was recovered from the Atlantic in New England within 90 min. after the launch.

The experiments, which made the flight on a "spaceworthy" test during a spooly scheduled test firing of the Jupiter, included the first U.S. attempt to obtain a behavioral response from such a test, although the Army previously had launched a squirrel monkey over the HSRM range in December.

The three, designated Monkey A-M, made the flight on a standard plan that led to a recovery position, the squirrel monkey, designated Monkey Felix, on a modified bed of cotton rather than a sponge position with known data to provide maximum stimulus to stress.

All four experiments included in the spooly were provided by the Surgeons General of the Army and Navy.

One of the other two experiments consisted of two small spooly-free containing small apes similar to children, the other two and apes of a six and ten pound weight were to test the effects of radiation and weightlessness on cell division and the fertilization process.

Fourth experiment, designed to reduce death primarily with radiation studies involving cellular systems including yeast, mice, mustard seeds, fruit fly larvae and human blood.

Denise of ARPA Urged by Farnas

Washington—Dr. Clifford G. Farnas, former Assistant Defense Secretary for Research and Development, urged last week that the Defense Department's Advanced Research Projects Agency be absorbed into the Office of the Director of Research and Engineering headed by Dr. Herbert York.

Dr. Farnas, now chairman of the University of Buffalo, said he felt that ARPA had served a useful function and supplied "some needed attention" to the defense effort but that it was time for the agency to be absorbed and its funds made available for use at the discretion of York's office.

Lt. Gen. Bernard A. Schwartz, commander of Air Force's Air Research and Development Command, also has called for abolition of ARPA and the transfer of its functions to the command of Research and Engineering (AW 10-4-6, p. 20).

Dr. Farnas, speaking at a National Missile Institute Conference here, said ARPA was established after the Soviet Sputnik I earth satellite in order to put the U.S. effort on a crash basis.

"But," he added, "these crash projects are strong evidence and should be used sparingly—used for fire and crisis. In looking at the best management as well as dollars and pounds pounds such projects actually realize the cost of the ongoing programs and can bleed it where. We can't handle our projects over the long run if they're being run on a crash basis."

Rep. Adam John E. Clark, deputy director of ARPA, defended the agency's role in the defense space program. He said:

"We like to deal with ARPA has provided the Defense Section and the nation with a working vehicle for ensuring the efficient application of such resources to our defense program. It is a space and other advanced research field."

Adam Clark added that while there was a continuing need for the agency, there had been considerable discussion in the Defense Department as to whether ARPA should become a part of the Research and Engineering Office. In one view, he said, there was the ARPA should not be absorbed because the ARPA program could become "bigger down."

Dr. Farnas also called for an end to inter-agency rivalry. He said:

"The problems of rivalry among the defense agencies in the research and development area have not improved and often appear to be getting worse. It is an old American tradition—and a valid one—that competition is a good thing. But inter-agency competition leads to rivalry. That is about where we are now and that's a poor way to run a national effort."

It was the fault of the military and civilian leaders of the three agencies, Dr. Farnas said, who are almost completely incapable, create hands-off and paralytic. One agency system drives other persons to work desperately to make his own service top dog. In the good old days, military and air space services even the long run if they're being run on a crash basis."

News Digest

Three-five companies were reported at two bodies' conferences at Boeing Airplane Co. last week discussing independent work connected with Boeing's position of the Minuteman SCRM program. Equipment suppliers for the elements of the subproject SCRM test program—service and technical factors and more elements of the ground station industry equipment—were subjects of the conference. Subcontractors for the test program of the program will be made in July, after evaluation of proposals submitted by bidders.

Catville service to Moscow with a stop at Warsaw is planned by Aer France, beginning in November. Airlines still needs approval of the Polish government. Two weekly round trips are planned with the two-way transport.

Shipboard radio transmitters that are difficult to jam will be produced by Westinghouse Electric Corp. under a \$7 million Navy follow-on contract. Equipment also developed for radio range, initial production contract was for \$12 million. Subsequent estimates are of transmitters.

Nord Aviation has sold a second batch of 26-11 nuclear propelled anti-aircraft missiles to the Norwegian armed forces. The missile is about 21 in. and cost per round is about \$1,000. Missile is to be the target and control of a gunner.

Germania-Galveston helicopter oceanic transport has been certified in Federal Aviation Agency. German firm has 45 orders for the 30-12 passenger corporate plane. The aircraft is certified as a scheduled air transport.

Thiokol Chemical Corp. and Marquardt Aircraft Co. have ended their merger discussions (AW 10-4-6, p. 23) with the decision not to join forces. J.W. Goetz, president of Thiokol and Ben E. Marquardt, president of Marquardt, announced that a thorough investigation by both companies "led to conclusions that a merger was impractical."

Boeing Model 92 VTOL-type test program will be started this month at Moffett Naval Air Station, Calif., following completion of repairs at BuAer Astronautical Co. Plant now damaged Feb. 15 during a landing at Moffett. Officials said accident was caused by misalignment in propeller control system and involved an SICA, or VTOL, flight characteristics.

Carriers Favor Tight Pilot Rules; General Aviation Raps New Plan

By Robert H. Cook

Washington — Federal Aviation Agency plans to upraise air safety by tightening medical qualifications for flight crews has been basically approved by the Air Line Pilots Assn. but is drawing heavy fire from general aviation sources who fear the proposal will result in a large-scale pruning of private fliers. The plan also is being opposed by the Flight Instructors International Assn. and the Transport Nurses Workers of America.

FAA's proposed changes to Section 25 of the Federal Aviation Act governing medical qualifications for airman certificates applied to all aviation pilots but general aviation spokesmen claim they are directed at their group.

Proponents of the section call for automatic denial of license to private pilots failing tests for diabetes, having a heart condition or a past history of mental illness.

FAA spokesmen say that the ground system group, which includes a refusal to have percentage of diabetic pilots susceptible to illness who now need only to pass a physical examination by a private physician to meet present medical qualifications, were selected in a review of 4,217 accidents and 950 fatalities in 1977.

Official records of the Civil Aeronautics Board and the Civil Aeronautics Administration show that the general aviation fatality statistic in 1977 was 10,918,800 ft. of flight as compared with a total of 71 billion for domestic

airlines which flew a total of 3,679,000 in 1977.

On the other hand, diabetes and the Air Line Pilots Assn. have strongly opposed the loose intent of the medical revision since they contend qualifications have been previously analyzed by both consumer groups and Federal Aviation Agency physicians.

FAA has proposed that all medical examinations for private fliers also be conducted by licensed, state-licensed physicians—a point that has not aroused any objections from most private doctors commenting on the change, although it does limit the finding of the influential Airman Medical Assn.

Vicious denials to the planned revision also are being made by the Flight Engineers International Assn. and the Transport Nurses Union of America, both of which characterize the amendment as "unreasonable" and a threat to their livelihood.

The engineers question the interpretation of much of the proposal, citing in support of the American Diabetes Assn.'s consultant on employment that diabetes controlling their illness by use of insulin prevent as special employment problems. FAA insists that changes to Section 25 would consider this condition as a drug, thus automatically disqualifying any applicant from an airman's certificate.

In particular, both FIEA and the TNU question the wording of the section which they contend would indicate that final judgment of applicant suitability would rest solely with FAA.

Civil Air Surgeon. The engineers' union points out that, in the case of private pilots, the American Diabetes Assn. advised the FAA that final determination of these applicants should be made on the basis of an examination by a panel of experts at the field. The engineers contend that this section should be applied to each of the medical categories since "regulation should keep pace with medical progress," said the union.

Physicians of the U. S. Department of Health, Education and Welfare, while approving of the changes on diabetes and heart conditions, found the provisions on mental illness "unduly strict and unnecessarily confusing." They are a source of past psychiatric history; many individuals eventually recover from the illness. They suggested that certificates be denied only when the applicant is known to have a chronic mental illness or is subject to a chronic recurrence of it.

FAA probably will limit much of this advice from medical circles and already has issued the proposal as a request for comment on independent panel of top medical experts. Further action on a panel appointment is being held in abeyance pending the official appointment of a Civil Air Surgeon. FAA says that, should the changes to Section 25 be enacted before the position is filled, it intends to consult a group of medical experts outside the agency in cases where applicants are made from regulation restrictions.

Turning the current proposal a "topping out" of what has been the customary practice of Civil Aeronautics Administration doctors, FAA says the upholding stands by the airlines and aviation medical authorities give the value of the proposal. Some changes in language are expected to be made, spokesman say, but other objections, such as the right of appeal and the granting of waivers, will still be considered in the revision. Actual coverage of special applicants was dropped from proposal to avoid duplication with Section 603B of the Federal Aviation Act and other parts of Section 25 which set forth testing procedures. Applicants denied certificates for medical reasons may still appeal to the Civil Aeronautics Board which will rule on whether the person has met the medical requirements of Section 25, and FAA.

Key issue in much of the proposal change centers about FAA's belief that all pilots should be examined by qualified agency doctors more familiar than general practitioners with the problems of aviation. The Airman Medical Assn. has strongly urged that more with a proven track record be selected by qualified aviation medicine, assert that standards established by the Civil Air Surgeon are by FAA approved.

Northwest Loses Monopoly, Gains Route

Washington—Northwest Airlines has lost its 32-year-old monopoly in the Chicago-Milwaukee-Minneapolis-St. Paul market, but at the same time it has no exclusive rights to serve Florida from the Twin Cities and Milwaukee with nonstop privileges.

In a final opinion by the Civil Aeronautics Board, Capital Airlines was authorized to provide Northwest with its last direct competition on the route between Chicago and the Twin Cities. CAB Vice Chairman Gene Gansau, in a unanimous and decisive opinion, ruled a strong showing by the additional competitors as what he termed "Northwest's total production impact."

In the same case, Eastern Air Lines' routes were extended into Milwaukee and the Twin Cities from Chicago. Round-trip routes were given to Capital Airlines from offering nonstop service between the Twin Cities and Florida since a decision from Member James J. Hefner, Missouri G. Joseph Shanks did not make part in the final decision.

Route Awards

Specifically, here are the route awards granted by the Board in its final decision in the Chicago-Milwaukee-Twin Cities case:

• Capital is authorized to operate the route between Chicago and the Twin Cities via Milwaukee without restriction.

• Northwest is permitted to serve Chicago on flight between the Twin Cities and Milwaukee and the Southeast. North will commercial service in December on its Chicago-Atlanta-Petersburg-Miami route awarded as the second Great Lakes-Southeast Service Case.

• Eastern was granted an extension of its route from Chicago to Milwaukee and the Twin Cities. However, in serving the new cities, Eastern is required to begin and end all flights at Nashville or points south and to serve at least two intermediate points between Nashville and Milwaukee. A similar extension has been placed on the route between the Twin Cities and Raleigh-Durham.

• United Air Lines is authorized to serve Chicago and Milwaukee on the same flight but will be subject to a requirement that such flights operate as far east as Cleveland and as far west as Omaha.

• Applicants at Washington, Delta and North Central were denied.

In its decision, the Board said it had found "undue impact in the existing service." It turned the Twin Cities-Chicago market a "monopoly market

which is capable of entering a second carrier." This accommodation, it said, when combined with "a uniquely clear market that has led to provide the highest standard of service to which the traveling public is entitled" justified competitive service.

Capital Authorization

In serving Capital at the second route to serve the market, the Board said the authorization would strengthen the airline's route network and being added as an improvement in economy of operations.

The Board admitted that the absence of proposed coach service by Capital was "the weakest link" in the airline's application but concluded that "the presence of Capital's authorization on Northwest should lead Northwest to take such a measure to offer further the coach passenger market."

In his decision, Gansau noted that Northwest operated 18 flights daily between the Twin Cities and Chicago during June, 1977. He pointed out that the carrier averaged 513 seats each on these flights each day and that additional flights have been scheduled on the route in the interim since 1977.

He said that the route accounted for 92% of Northwest's total domestic air miles enroute and suggested that the proposed flight of Eastern and Capital on the route would "effectively destroy the Chicago-Twin Cities market to the detriment of Northwest."

dissemination of Northwest's profit pattern" and added:

"I cannot agree with such a decision which justifies that benefits to Northwest of the addition of air Florida routes by placing multiple competitors in Northwest's most productive segment."

Delta was cited as a troubling threat against North Central in its petition to serve the route. The Board said that the route is a high demand market of sufficient length to be attractive to a transline carrier. It stated that North Central "cannot" compete with its Carrier against Northwest's larger equipment without additional subsidy which other airlines can do without any cost to the government.

Delta Eliminated

In its decision on the southeast air route of the case, the Board eliminated Delta on the grounds that "on an individual basis, Eastern will be able to provide most 5,000 seats passengers, with no-carrier service there could Delta." The Board admitted that Delta is the "member of two carriers and that the route would strengthen the economic position to provide a better competitive balance between it and Eastern."

It concluded that the public interest outweighed the "need for strengthening" Delta often cited by the Board in setting route cases.

In involving the nonstop privileges to



Turboprop IR-18 Makes Test Flight

Outward delivery of the 4,000 hp. Kawasaki turboprop engine on an Aerobac IR-18 transport is shown during a development flight test. Aircraft will be in service on the Missouri-River and Missouri-Alaska routes, according to Aerobac. Position on top of right wing, over the wing by its tail fin.

DH-121 Design Changes Proposed

London—Changes in the specification of the de Havilland DH-121 allowing both one and engine configurations are likely to be encountered early by British European Airways.

Unofficial reports indicate that BEA wants a smaller version capable of accommodating about 100 passengers instead of the 160 specified in the original project. They would keep the thrust requirement into the range of a two-engine installation which is considered most economical from the present airframe layout configuration.

It is not clear whether the new BEA thinking is based on a late evaluation of the market after 1984 or whether it simply reflects the impact of two-engine airliners on the one of operational characteristics of the aircraft. With the new BEA, any before it necessary to accept a smaller seat capacity in order to optimize the design around a two engine installation.

Officials at de Havilland say that the making out of a certificate is a continuous process which in a case "has not yet crystallized." They now shudder before the changes BEA has proposed and are reluctant to be involved. The company has to off the aircraft in the world market to break even. A smaller aircraft design too late, it is believed, from what de Havilland estimates will support the world requirements in 1985 and after. To optimize the market around the new BEA, agreement would consequently penalize the sales potential elsewhere, officials claim.

Reports that the Vickers VC-10 specification also was under review were later been dismissed by the aircraft company as "falsely understood."

What Lockheed is doing today to develop Tomorrow's missiles and spacecraft

The world's first polar-orbiting satellites... the world's fastest target target drone... a "fuel cell" that produces auxiliary power for spacecraft as a radically different way... a TV camera-transmitter—the world's smallest—that gives engineers and scientists on the ground a televised report of what takes place in test missiles during flight. These are just a few of the many activities and achievements of Lockheed's Missiles and Space Division.

Lockheed is System Manager and Prime Contractor of the ARPA Discoverer satellite series—and the U. S. Navy's POLARIS missile. Both are highest priority programs of the U. S. Government. And both are ahead of schedule.

A Lockheed MSD work-force of over 16,000—including 3,500 scientists and engineers—is engaged in all phases of missile and space technology: satellite systems development, space communications, electronics, logic, nuclear and solar propulsion, magnetohydrodynamics, computer research and development, flight simulators, materials and processes, human engineering, electromagnetic wave propagation and radiation—and many other advanced fields.

From these efforts at Lockheed will come many significant breakthroughs and scientific "firsts"—to speed the development of tomorrow's missiles and spacecraft.



Jet-powered supersonic target, Lockheed Q-3 supersonic electronically steered using radars—a target used by U. S. Army to evaluate and sharpen our nation's missile marksmanship, increase our defense capabilities.



First polar-orbiting satellites, the Lockheed-built Discoverer I and II were orbited in two successive launches. Lockheed is System Manager for this ARPA advanced scientific research program.



Transmitting performance data from missiles and test vehicles, direct to ground stations, Lockheed-developed TV camera-transmitter and PAM-TM telemetry system are acknowledged to be the world's smallest, world's best.



Revolutionary "fuel cell," under development at Lockheed, converts chemical energy directly into electrical power—for auxiliary power requirements of man-made spacecraft instrumentation and space communications systems.



Launching from beneath the sea, a full-scale POLARIS test vehicle demonstrates how operational missile will be launched from submerged U. S. Navy subs. Ultimate range of the POLARIS will be 1300 or greater miles.

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**AIRCRAFT
SPARK PLUGS**

ORDERED BY
Rensselaer Corporation • Pacific Airplane Corporation
Bentley Aircraft Company • Standard Aero Supply Ltd.
Van Dusen Aircraft Supplies, Inc.

Airline Income & Expenses—First Quarter, 1959

(In Dollars)

	Passenger Revenue	U. S. Mail	Freight	Charter	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income (Before Taxes)
DOMESTIC TRAFFIC								
American	91,442,563	1,383,142	4,737,094	1,270		97,563,069	75,491,963	22,071,106
Boeing	13,446,889	463,645	919,735	66,760		14,836,989	14,442,738	2,394,251
Continental	32,194,312	508,126	937,141	94,904		33,634,483	30,645,061	2,989,422
Eastern	7,116,884	154,718	283,203	38,928		7,593,733	7,481,879	111,854
Delta	23,212,029	463,457	1,849,742	18,249		25,543,478	25,017,176	526,302
Eastern	46,120,284	1,048,200	2,419,267	183,590		49,668,341	46,984,524	2,683,817
Northwest	46,119,234	1,048,200	2,419,267	183,590		49,667,291	46,983,284	2,684,007
Northwest	7,992,511	118,211	387,848	14,408		8,512,978	8,444,349	68,629
Northwest	7,652,281	228,291	474,940	7,126		8,362,638	8,275,867	86,771
Pacific World	84,802,381	2,163,519	3,006,441	123,208		90,995,549	86,664,302	4,331,247
Pacific World	84,802,381	2,163,519	3,006,441	123,208		90,995,549	86,664,302	4,331,247
United	11,444,762	228,192	201,460	41,737		11,916,151	10,391,449	1,524,702
INTERNATIONAL								
American	1,282,449	8,923	149,844			1,441,216	1,381,999	59,217
Boeing	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
Continental-Rexford	746,467	7,454	41,244	1,947		806,112	623,452	182,660
Delta	5,144,268	13,250	60,606			5,198,124	4,911,716	286,408
Eastern	8,616,000	78,017	321,261	10,270		9,025,548	8,504,329	521,219
Northwest	41,103		1,773	1,627		43,503	42,408	1,095
Pacific	4,931,647	1,022,350	1,022,350	4,227		6,980,574	6,907,645	72,929
Pan American	489,761	33,014	86,203			608,978	5,073,480	440,798
Alaska	20,332,028	2,102,449	3,048,983	387,475		25,870,935	21,143,872	4,727,063
Delta	16,491,907	97,074	467,883	7,123		16,663,987	16,323,748	340,239
Pacific	10,610,603	1,779,094	3,431,977	1,608,197		16,430,771	15,964,337	466,434
Panagra	5,302,107	126,162	433,770	14,129		5,876,168	4,606,159	1,269,999
Alaska	1,264,744	38,478	1,811,680			3,114,902	1,408,404	1,706,498
Northwest	4,931,647	1,022,350	1,022,350	4,227		6,980,574	6,907,645	72,929
United	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
Boeing	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
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Pan American	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
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Alaska	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
Delta	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
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Delta	1,248,167	38,712	116,233			1,393,112	1,276,436	116,676
Panagra	1,248,167	38,712	116,233			1,393,112		

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\$14,995 The best looking, modern, low-wing airplane, the 180 horsepower Comanche has all the features you want for top economy and efficiency—laminar flow wing, single-point jet-type stabilizer, swept cowl for 180 mph cruise. Means 206 hp operating cost than for any other aircraft plane with similar performance. Add to this the fact that the Comanche has the biggest, roomiest cabin, by far, of any three-engine business airplane. Definitely the outstanding buy at the \$15,000 price class.

\$16,575 Buy the Custom 180 hp Comanche. All the rapidly, very-valued features of the Comanche plus full advanced instrumentation panel including gyro horizon, direction gyro, electric trim and lock, plus 140-watt VHF transmitter, Dual-navigation, VHF receiver. Here's a well-equipped, 180 mph, modern, low-wing, all-weather, all-terrain airplane with maximum economy and wonderful all-around performance. Here's real value, and safety—the best, by far, of any airplane in its price class.



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\$18,995 You'll have to spend over \$5,000 more for a very advanced airplane with performance comparable to the Comanche 250. It's powered with the smooth, rugged 250 horsepower, six-cylinder Lycoming engine, which is expected to give you far more operating hours between overhauls than any other comparable engine. The Comanche 250 is conservatively rated at 181 mph cruising speed, has 66 gallons standard gas capacity, far more cabin, baggage room, payload than anything in its class.

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Check the equipment, check the cost, check the cabin space, check the power plant, check the payload, check over-all performance and economy of operation, double check what you get for your money. You'll see the Comanche is your logical choice. See your Piper dealer or write for brochure, Page 10-6.

PIPER

AIRCRAFT CORPORATION, LOCK HAVEN, PA.

ATTRACTIVE LEASE AND FINANCE PLANS

SHORTLINES

► Continental Airlines plans to introduce additional Boeing 707 service from Chicago to Kansas City and Los Angeles and Chicago to Denver and Los Angeles on Aug. 5. By the end of the summer, Continental plans to have six daily round trip flights between Los Angeles and Chicago with three morning and two night-stop flights via Denver and one single-stop flight via Kansas City.

► Eastern Air Lines will begin its daily morning flight from New York to Fort Lauderdale, Fla., on July 1 using Lockheed Super Constellation aircraft. One flight will be a day coach and the other night coach.

► Eastern Air Flight Corp. reports a first quarter net income of \$179,175 after taxes and operating expenses on revenues of \$1,699,464, which rose up 85% over the same period in 1951. The net income figure showed a 50% increase over the first quarter of 1950.

► Flying Tiger Line revenues for April showed a 27.1% gain over the same month of last year, totaling \$1,168,661. The carrier's rising month-to-month decrease increases over the previous period, with the net income figure up 166% to \$1,271,814. Gross revenues for the six months ending May 31 amounted to \$3,837,566, from \$3,242,817 in 1951. Operating expenses declined from \$2,198,860 to \$2,286,873.

► Los Angeles Board of Airport Commissioners has awarded a construction contract to Peter Kiewit & Sons Co. on a low bid of \$5,587,707 for the first proposition as the first step in construction of the new passenger terminal complex at Los Angeles International Airport.

► New York Airlines' fleet of five Constellation aircraft has carried 300,000 passengers since their introduction in 1947. New York Airlines says it is the first helicopter carrier to transport more than 100,000 scheduled passengers.

► San Francisco Board of Supervisors has appropriated \$8,544,000 from a 1950 airport bond issue for construction of a satellite terminal intended to pay for plane loading, landscaping, runway paving and fuel.

► Trans-Canada Air Lines has taken delivery of its 51st and final Vickers Viscount aircraft. In addition, TCA has on order six Douglas DC-8 and 22 Vickers Viscount aircraft.

AIRLINE OBSERVER

► Pan American World Airways will "activate" its Boeing 707-120s now in transportation service to Latin American routes when its long-range Boeing 707-120s and Douglas DC-8s are phased into service. First three 707-120s are scheduled for the Pacific Division, the first to enter scheduled service 45 days after delivery in July. However, Pan American has no plan for operating any particular type of aircraft consistently to any division. Equipment exchange program with National Airlines would allow long-range equipment. Assignment of the 707-120s to Latin America does not preclude ordering new medium-range jet equipment for those routes.

► Watch for Chicago Helicopter Airways to order three Sikorsky S-61 triple turbine helicopters to handle increasing traffic.

► Northeast Airlines is formulating a plan that may bring about the introduction of turboprop equipment on its New England-Hawaii route by "late fall."

► Federal Aviation Agency has requested a Civilian Transportation Advisory Group to start in the development of an aircraft culture prevention device. Group will work in three main areas—completing of aircraft, passenger warning indicators and collision avoidance system.

► Load factors of six local service carriers declined by 15% points in April as compared with the same month of last year. Request this was made by Frontier, with Lake Central registering the largest gain of the six carriers.

► International Air Transport Association has advanced its first spring traffic conference. The meeting, held in Birmingham, Scotland, was designed to handle procedural matters of the conference and to achieve the resolution of the regular annual conference which deals with policy, fares and rates. This year's conference will be held in Warsaw beginning Sept. 22.

► Russia's Aeroflot plans to establish a number of shoreland training centers, the first of which already is being organized in Moscow. Aeroflot believed that by Aeroflot service shoreland lands that carry thousands of passengers will receive such specialized training at airports without qualified instructors, training materials or cabin equipment.

► Midwest Airlines' fleet order has been fixed by the Civil Aeronautics Board following its decision to reduce a number of the carrier's 100-hp twin-engine turboprops to the extent by the Douglas, Lockheed and Western Railroad. The railroad was permitted to increase, and a hearing on its operations was held in February. The Board, however, found that by failing to file the equipment to the carrier's rating, "Lockheed has in effect abandoned and withdrawn its objection."

► Moscow, Egyptian national airline, has been granted foreign exchange credits that will permit it to buy turbine-powered equipment from other the French at Latham. Last year, the carrier was believed to be ready to purchase the Boeing-Bell 74-104 turboprop, but the Soviet had indicated that it might be required to accept payment for the planes in Egyptian currency (AW News 3, p. 45). However, the Egyptian carrier has favored the de Havilland Comet, not only that it has foreign currency, can be expected to place an order for a fleet of the Comet 4.

► Eastern Air Lines has placed an order with Doherty Corp. for six fixed flight simulator attachments with an option for two more. Eastern, still unable to acquire the pilot training device, will use the closed circuit TV system at its low visibility approach instrument flight training program.

► Check Air Lines board chairman and president, Leslie H. Hershman, has been granted a leave of absence by the company's board of directors because of ill health. All activities of the carrier will be handled by Joseph E. Fitzgerald, who has been named executive vice president and general manager. Fitzgerald, former Civil Aeronautics Board staff director, joined CAA last June.



INCREASE IN SOVIET air travel is illustrated by the view of Aeroflot transports at Moscow's Vnukovo Airport. Five transport Tu-114s are lined up in the foreground with a long tailfining Antonov An-10. Between tails of the first two Tu-104s and numerous B-16s in the background. Aeroflot claims to have served twice as many passengers during the first quarter of 1968 as in the same period last year (AW May 11, p. 45).

Soviet Hints at Early Mach 2 Transport

Moscow—Western aircraft manufacturers who predict that a supersonic transport project might not be in operation until 1975 "are wrong—very wrong," Soviet aircraft designer Artyom Mikoyan told British European Air was officials in Moscow after negotiations of BIA's London Moscow service.

The Russians are interested in development of supersonic airliners, Mikoyan said, and also are developing a fully automatic blind landing system. Officials said the Russians have asked to export the British blind landing system and not undergoing trials at the Royal Aircraft Establishment's Bedford facility.

Mikoyan, brother of the Soviet deputy prime minister, noted that the first jet to operate in travel will be the first to operate in commerce. He added that the aircraft would have to be in the Mach 2 range and, at its economic necessity, would have to be operated at very long range.

Aircraft Inspected

In other developments, the BIA party

- Inspected B-15 and An-10 transports.
- Learned that Aeroflot, the Soviet airline, is considering helicopter service from Vnukovo Airport to the Moscow metropolitan airport.
- Inspected "griffins" of the Lavochko Soviet attack naval landing aircraft in the London Moscow route.
- Learned Pavel Zhigunov, Aeroflot chief, told Richard Fawcett, British

air chairman who was a BIA guest, that the Tu-114 transport project now is in development trials in the East and may be active in Aeroflot flights next year.

Zhigunov told the BIA group that the five points outside Russia which will be served by the B-15 will be Reykjavik, Pango and Stockholm. Both the B-15 and An-10 were described as "unprecedented records" after its inspection by the BIA visitors.

An-10 Configuration

The An-10, also designed for cargo use, has a 35-foot configuration that can be stretched to 100 ft for high density operations.

First test has its own radio tower in the background that is operated from a remote site in the flight deck.

In a discussion of later Lord Douglas

of Kirtlington, BIA chairman, told Ambassador Wicks he plans to call an ad hoc meeting of all airlines serving Moscow to discuss lowering of fares on their routes. This group then will be a body composed of IATA (International Air Transport Association) with one representative.

He indicated a 15-17% cut would be "about right."

The BIA group also was told by Aeroflot that the British airline has been granted "adequate" facilities at Riga and Minsk. The Russians have offered an alternate at Vellore Lata, west of Moscow, but BIA executives said this facility would be used only in an emergency area, it is considered below par.

BIA's Vnukovo blind landing tests parts will fly the Moscow route with low-density seating, 32 passengers in mixed tourist and first class. The An-10 has two air seats, a profit on the run with a 15% load factor due to its long standing flight from the Copenhagen airport, and low turbine costs.

Students will have only one permanent representative, no agency fees and no advertising costs.

Soviet Cargo Promised

The Russians have informally advised BIA they will attempt to cut flight times of passengers by sending cargo-carrying cargo available. However, several flights so far have been vetoed. BIA with Russian delegations or have some representatives.

CAN "MATCHED" SERVO COMPONENTS



IMPROVE SYSTEM PERFORMANCE?

They certainly can! And if performance in your servo system is important, you owe it to yourself to check out the advantages "matched" servo components by Kety can give you.

For example, Kety's 10512V Receiver (designated by the Bureau of Ordnance as Mark 1) trimmed to the THERA 4-100X Amplifier gives you a bonus of high performance and interchangeability:

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Similar benefits in matched performance can be obtained with system combinations using Kety's speed transmitters, transformers, receivers, differentials, transducer servo amplifiers, and servo motors.

But performance is not all you gain. When all or most of your components are from Kety, broader technical assistance is assured, and service and spare problems are simplified.

Kety engineers are working on many advanced environmental and accuracy problems in developing prototype systems. Why not call or write for help in solving your servo component problems?

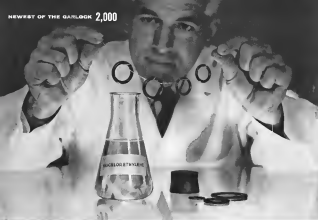


Division of United Aircraft Corporation

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Kety matched components—transmitters, receivers, speed transmitters, transformers, servo amplifiers, servo motors, differentials, and speed transmitters.

Circle 10 on Reader Service



New Garlock Viton® Rubber Parts Offer You Low Swell in Solvents, Resistance to 600°F.

LOW SWELL, GOOD TENSILE STRENGTH DESPITE HEAT, SOLVENTS. Today's mix of hazardous, high-power fluids that rubbers are able to withstand not only corrosive fluids alone—but high temperatures alone—but a combination of both. Garlock's new Viton rubber parts do exactly this. It's the only known rubber that will maintain low compression set, low swell, and good tensile strength as combined with acids and contact high temperatures.

IMMERSED FOR SEVEN DAYS. For example, Garlock Viton retains its data, tensile strength, and elongation characteristics when immersed for one week in twenty of the most widely used—and perhaps harshest—solvents, lubricants, fuels, and acids on the market today. In the test illustrated two O-rings of ordinary Nitrile rubber and two rings of Viton were immersed in trichloroethylene. Viton (right) retained its original dimensions—the Nitrile rubber (left) swelled almost 50%.

OVEN AGED AT 600° F. Viton can be oven aged in air at 600° F. for 24 hours, and at 400° F. for 2400. In both cases, it not only retains its excellent mechanical properties, but it remains perfectly elastic, proving its value in either intermittent or continuous application.

OPENS MANY NEW USES. Jet and missile are the more obvious applications for Garlock's new Viton parts.

applicable military specifications for military aircraft, etc.). However, Viton is finding important new civilian uses as valve stem seals on truck engines, pump seals on automatic transmissions, and on gasoline pumps, thermostat bellows and domestic washing machines—practically any mechanical equipment where you need rubber parts which give maximum resistance to deterioration by liquid or heat.

Viton is also available in sealing elements in KROCK®** Oil Seals, flexible members in MECHANIPAK®** Mechanical Seals, "O" Rings, Gaskets, CHEMSEAL®** Fittings. Viton products are the result of the Garlock 2,000—two thousand different styles of packings, gaskets, and seals for every need. The only complete line for your best Garlock representation, or write for further information.

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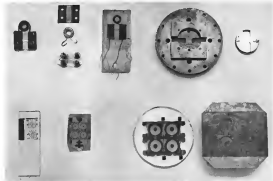
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SPACE TECHNOLOGY



EVOLUTION of a million-second superconducting memory element, as developed by STL's Physical Research Laboratory. Completed and in those that have left in bottom row. The unit to its right is a dotted work unit to give the view.

Space Technology Laboratories—Part III.

STL Integrates Space Probe Payloads

By Irving Stanc

Redwood, Calif.—Space Technology Laboratories, Inc. is continuing work on space systems begun last year with the Air Force Inertial Guidance and the Advanced Research Projects Agency's Project Space studies.

Experiments entered through this view and are prepared by the National Aeronautics and Space Administration.

STL is providing the basic structure, guidance and telemetry for a set of NASA space experiments, with instrumentation being supplied by University of Minnesota, University of Chicago, Stanford University, Air Research and Development Command's Cambridge Research Center and others.

STL integrates this instrumentation into the package along with instrumentation it has developed itself. It also supplies and operates ground station equipment that will be used for both tracking and command control at



SAMPLES shown are used to determine characteristics of this film reproduction.



MELNICK-CRIDER usage converter circuit is used as a suspended guide exponential in a susceptibility/bioelectronic study. Circuit is aimed at optical system (arrow) installed at flight.

Hawes, Manchester, England, and Cape Canaveral, Fla.

Dr. Adolph K. Thiel, former director of STL's Test Program Office, is directing this major systems planning.

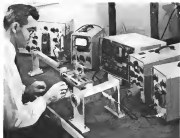
For the USAF laser guide, STL developed a four-instrument transponder weighing five pounds that would do a job that normally would require 200 to 300 lb of equipment, according to Dr. George E. Mueller, STL vice-president and electronics specialist. Dr. Mueller is assistant director of the Research and Development Division. The transponder, he said, still is being refined. Such weight savings is necessary and increasing command capability to approximately 12 channels.

Both of STL's pulsed work is centered in the Electronics Laboratory which also includes bioelectronic, electroacoustic, and guidance research activities. This laboratory also does system engineering and technical direction for weapon systems in the areas of guidance, control systems (radio pilot, hydraulic systems, etc.) and ground support equipment. This effort is directed to research development phase and to early operational program.

More difficult aspects of the Electronics Laboratory's work involve design and optimization of the guidance equations, criteria and interface specifications, specifications for checkout of ground support equipment, flight test procedures and analysis. An example of this effort is Project Scare, the USAF-Cougar Atlas missile jet role which last December

for Advanced Research Projects Agency. It was possible to develop guidance equations, analyze the control system and simulate the overall system for the Scare flight on a very short time-scale under very stringent security restrictions, largely because of the accumulated knowledge of a staff group in the Electronics Laboratory, Mueller said.

Scare carried an Avco Signal Corp.



RADIO frequency study is used in STL's Physical Research Laboratory for experimental control of electron and a physics in study of controlled thermonuclear power.

communication payload. STL was one of the three groups in the U.S. that were able to predict trajectory with accuracy, Macfarland. Others were the Sandhollow Institution, which used optical sensors, and NASA, which used the Navstar system.

Analysis of characteristics of the components of a guidance system—power, acceleration, platform, ship, radar, etc.—is another Electronics Lab major activity for prediction of the accuracy and operational problems prior to actual construction of the system. This was done for the USAF Atlas Titan Thor and Minuteman missiles before the contractor was brought in, in order to prevent rough operational requirements to the builder. After selection, the contractor and STL performed detailed studies to predict final system performance.

About one-third of the Electronics Laboratory's effort is devoted to aid direct system studies, component research, and environmental studies. An example of the latter is ionosphere studies just completed after about two years of research. This work has a bearing on the characteristics of the ionosphere which in turn has a bearing on accuracy of radio guidance. Findings are sufficiently firm to be handed out as advanced guidance development. In this same field, STL is coordinating the efforts of the University of Alaska-Northwest Branch of Fairbanks and other groups where Air Research and Development Command's Ballistic Missile Division is supporting similar work. STL is conducting similar studies on the ionosphere in cooperation with

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to design and make systems,
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This 10-channel, 500-circuit analog processor in the TAPCO Group is able to speed the engineering of complex devices, and also simulate multiple-channel operating conditions for control systems.



AT TAPCO... 10,000 people
combine every talent needed to
create systems, subsystems, hardware

People at TAPCO... over 10,000 of them... are fully competent in the design and production of unusual rotating machines to handle fluids, electricity and high temperature gases. They have broad experience with unusual parts and structures requiring special treatment to shock, temperature, and corrosion... can produce components of all types in space-age materials and unusual alloys of common metals.

Development of unusual alloys and ways to fabricate them are nothing new to TAPCO people. More than 55 years of experience in metallurgical developments, fabrication and heat-treating methods, and unusual welding are available at the TAPCO Group.

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"Digital machining" of special alloy steel cases for turbine compressor engines by hydroforming, or roll-forming, at a high production rate in the TAPCO Group facilities.



Manufacturing of turbine, compressor and engine parts by TAPCO Group.



Facilities at TAPCO to turn
unusual ideas into systems,
subsystems, components

From conception to final delivery, TAPCO facilities provide for all phases of design, prototype, manufacture, and testing of a complete system, a subsystem, or major components of a system.

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The 12 plants within the TAPCO Group have 3,000,000 square feet of engineering and manufacturing area, half of it under one roof. Research and development equipment, production machinery and other facilities are valued at \$150,000,000.



Specialized super-velocity turbine and compressor hardware testing are accomplished facilities that include use of white liquid lubricants without lubrication is facilitated and supported by continuous design and engineering testing while maintaining excellent cleanliness of 1-100,000 to 100.



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The Tarnco Group has a broad experience with the behavior of all types of fuels under all conditions, from ground level to highest altitudes. This experience has contributed to the design and production of over 1,100,000 aircraft and missile fuel pumps of all types.

Experience is the Tarnco Group also includes nuclear-reactor engineering, production of high-speed rotating machines to meet all temperature problems, and development and production of self-contained auxiliary power units of various sizes, duty requirements, and configurations.

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The Tarnco Group designed and supplied the entire fuel system, forward and aft drive, and auxiliary system for the Boeing Model B missile defense of the first operational site at Eglin and Bell County Air Force Bases. Tarnco also provided full field supervision to their assembly and demonstrate functional operators.



Produce oxygen, hyperoxygen systems, core for high-speed operations in auxiliary power unit. Develop and manufacture in Tarnco.



AFU developed and built by the Tarnco Group for use with missile fuels. Testing was done under simulated operating conditions at Tarnco's 1700-acre Research Test Facility.



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AVIATION WEEK, June 1, 1959

and in exploration of the program. These new studies at STL and Convair last summer on rocket engine capabilities of an early Atlas missile. STL experts contributing to optimum performance under consideration—propulsion, guidance, weight, drag—and both Convair and STL made extensive test work and STL prepared a statement for submission to Washington officials, stating that the Scout mission was feasible and outlining overall program considerations. STL and Bell Telephone Division were directed to implement the program under maximum security.

STL was required to plan the program—each component would be required, which would do what design with a minimum number of people, to maintain time schedule. STL was required to formulate the minimum performance required, state available Atlas missiles and their components, and select the missile most suitable for the job. Particular reference was made to engine test data from North America's Rockwell Division, which had been collected before delivery of the engines to Convair several months earlier.

Weight Reduction

Together with Convair, STL considered each missile design for weight and performance, and decisions were made on what items could be deleted for the mission and whose special design changes were warranted for that single shot. This resulted in every significant weight reduction in Atlas 10-B, the missile selected.

STL obtained information on the characteristics of the communication package required to be supplied by the Army, and technical direction for installation of the package was given to Convair.

Various agencies were studied, investigation was given to the requirements by the communications package, and technical direction for installation of the package was given to Convair.

Guidance, navigation and guidance systems were calculated by STL, with appropriate program data to fit the guidance system to the missile for performance of the specific mission. Guidance hypotheses were then studied and Convair indicated the attitude guidance system to give proper look-angles in a bank of the difference between this system and that used for a second Atlas flight.

Guidance guidance computer elements were provided to Burroughs Corp. for acquisition at Air Force Missile Test Center, although Burroughs was not told specifically what services were required. Guidance simulation tape was prepared by STL to check out the

guidance computer, various fuels, launch device guidance data transfer, missile was modified in accordance with STL decision to give instant indication at the predicted apogee and position during the last portion of the powered flight.

For complete security, in appropriate high level test plan was prepared. It was then imposed at the last moment by the test test plan to which only a limited number of persons at ATMITC had access.

Prior to mission security in studying a change now came to improve certain normal payload tests and to give site specific usage which criteria, near all accomplished in part of the system engineering job.

The flight produced considerable data valuable to the Atlas missile program.



DR. LOUIS G. DIME

Dr. Louis G. Dime, president of Space Technology Laboratories, studied the behavior of liquid fuels under all conditions, from ground level to highest altitudes. This experience has contributed to the design and production of over 1,100,000 aircraft and missile fuel pumps of all types.

A system with complete files, complete data and complete processing . . . to handle all operations.

It's a proven fact . . . that of the total work necessary to put a missile into the air, a staggering 90% is primarily logistical and involves the control of many individual maintenance parts. This figure becomes compounded as the number of inactive, but ready-to-fire missiles increases . . . and keeping track of their individual needs becomes a herculean task.

It is clear that an efficient system of organizing, filing and searching great masses of data at high speeds, and at realistic costs is necessary. The Magnavox Corporation answers the need for "discrete" unit data to record headquarters for both government and industry with Magnacord.

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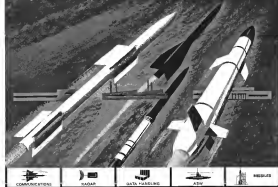
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DATA HANDLING EQUIPMENT BY

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according to Dr. T. B. Hall, SILL vice-president and executive director of Systems Engineering Division.

The type of technical work performed by SILL's Computer and Data Reduction Center in connection with the Air Force Missile probes illustrates the importance of this activity which has a status equivalent to a division.

The center did computing on high speed digital units to assist in the guidance analysis and performance design of the missile guidance—fire three stages plus the parked stage and the status evaluation. It also computed the path the vehicle would have to use if to reach the targets of the enemy. This involved the simulation of a simulated trajectory. Tracking stations and this to begin making the missile as light. Obtaining a more accurate allowed determination of actual trajectory. Computations were fed into the SILL computer at frequent intervals to determine a new predicted trajectory. This new information was fed to the tracking stations to tell them where to look. Stations in turn fed the observed trajectory back to SILL, which incorporated, and new trajectory data again sent out to advanced stations. The process was repeated in a closed loop system, with the trajectory estimator being running lighter and lighter for a final determination of the path.

A number of new techniques are being pushed at the Computer and Data Reduction Center in connection with work for RAND. They include:

- Studies of new earth satellite orbits to determine trajectories more accurately, provide better missile data for the vehicle. Thus, new earth orbits range from a few hundred miles above, out to about 70,000 mi. and include orbits sufficiently low that the earth's atmosphere and obstructions present effects that cannot be too well predicted. SILL is using other parameters such as eccentricity, inclination and semi-major axis as the unknown, rather than the position and velocity of the satellite, for a method of tracking.

- Investigation of advanced techniques in connection with non-inertial probe studies. SILL wants to compare usual methods of computing interplanetary trajectories to determine which is the quickest and most accurate. In effect, this is a comparative procedure to actual true capabilities. Two or three approaches are being used in this study.

- Progress for development between signal and noise in radio reception from distances up to millions of miles. Both refinement of equipment and new mathematical techniques of information theory are involved. This will include setting up formulas to be applied to the upper limits to extend astronomical information from the radio record. Studies are both theoretical and experimental. Mathematical methods have been fo-

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related and equipment has been designed by STL's Electronic Laboratory around their sophisticated methods, to integrate some electronic behavior signal and noise. STL wants to ensure better resolution of data than has been obtained from earlier probe shots. Digital filtering functions are being incorporated to improve data processing.

• **Approach to Air Force** to perform work in the field of selected mechanics, partial differential equations, transfer function analysis, and optimization of mechanisms with respect to payload. This work is motivated by specific requirements which already have shown up in future missile and interceptor missile projects.

• **Mathematical research** in information theory and data handling to develop techniques for analyzing remote flight test data. This is based on earlier studies from various ICRM flights. One of the toughest problems has been extrapolation in blackouts of telemetry data. STL is trying to get into space guidance formulas with shock up to 10 g.

• **Digital computer** program to allow simulation of a fairly general class of computers. This would allow STL to evaluate new designs for digital computers. In effect, STL's approach is to solve mathematical equations of its general purpose computer (IBM 704) into the proposed design.

• **Computer program** to permit optimization of various control design. One is that there is still an element of guesswork in selecting the best values of parameters that go into analog designs—for example, damping, weight, and mechanical factors such as shaft thickness. STL's aim is to design a computer-aided method that will permit the computer to select the optimum values of the system variables.

Computer and Data Reduction Center is headed by Dr. E. Rime. It has more than 100 technical staff members who have aerospace or engineering degrees.

About 15 to 20 field scientists in mathematics and physics. The change that STL is making with new, "long-lived" important scientists, is informed, STL's President Dr. Louis G. Davis defines emphasis with. He says that the company's technology and research, in the area, have been "through the roof," and have had extreme experience with hardware. But Davis does not deprecate the value of the theoretical contribution.

"We have and will continue to use scientific talent—pure physics and mathematics—because many of the problems now only can be solved by such, three areas," he said. As an example of "long-life" contribution, he said, are the computer programs developed for the GE guidance system,

which were turned over to Titan ICRM. "As we move into the general area of space, we will have to rely more heavily on the physical and mathematical sciences . . . to more fully demonstrate the theoretical will take an immense emphasis than he has in the past," Davis predicts. He points to the technical problem: "We will have to take into account the gravitational field of the whole solar system. We must first establish a mathematical model that translates the mathematical problem into a computer and good but the right path." This is a complex example, but the mathematical formulation is not simple, Davis emphasizes. He also stresses the importance of theoretical and practical aspects. "As you move away from the ideal system, you must understand what the practical considerations will be."

One big area of development in the future, will be communications and communication techniques, Davis predicts. Efforts that space system has in radio communications now is a pretty much an unknown, he said. "Within the next five years, bigger contribution will come in the field of developing weight and bearing equipment like solid-state physics will play an important part in the solution of some of these problems. We have already an important part in developing, sound engineering," Davis believes.

Solid propellant has been considered in space applications," he said. "I don't think there's a lot of a place, but some of the special lightweight propellants will be developed in a particular, usable state, for space applications, particularly for liquid and third stages." However, and liquid launch will be pointed to use but Davis would not specify a time.

One of the important national contributions, Davis believes, is the need for a large national research program and development effort in the space field, not an effort that is based on and off, so that work can be pursued in some of the problems that will have to be met by the nation now.

"We should have our own national program and should not be unable to do it," Davis stated. "It comes out of the Russian game," Davis said. "There are many space systems being that require attention. We want attention that the Russians have an inherent lower competence and no cost but then to even more. Performance may be high, but it's not there. It should be the measure of what we are doing. We can't be judged on a blow-by-blow basis. This doesn't mean we can't change, but we must consider changes on a regular basis."

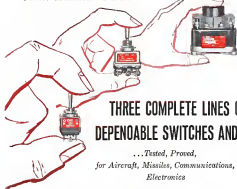
STL, the top of these activities are Space Technology Laboratories Inc., 10000 W. Wacker Drive, Chicago, Ill. 60601, or STL, 3101 N. 1st St., St. Paul, Minn. 55101.



Tube Reproduces Interplanetary Shock Waves

Shock tube that reproduces interplanetary shock waves traveling at velocities greater than 1000 ft/sec. is shown at Aero Research Laboratory (ARL) May 15, p. 175. The working gas is hydrogen at very low pressure. Flow below wave of pressure dissipated from a ball of combustion in about two microseconds provide the energy that launches the wave. Gas temperature behind the shock wave is about 1,500,000°. At these temperatures the gas is completely ionized.

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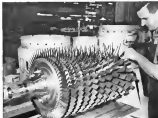
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ADVIS-401C INFORMATION INTERCHANGE. A Bell-Boys representative, member of the AGT Division, here discusses new design concept with Westinghouse technical management. The Bell-Boys/Westinghouse long-term agreement permits faster yet engine design and production cycles.



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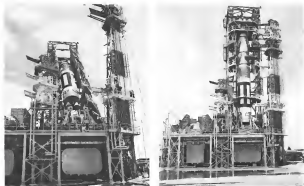
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First stage of a Martin Titan intercontinental ballistic missile (top left) is mated from a Douglas C-130 transport at Cape Canaveral, Fla. Titan below shows rear view with 110,000 lb. thrust Aerojet boosters threaded. Stage is moved on transporter (right)

Air-Transported Martin Titan ICBM Assembled,



Crane arm is being used to mated position (left) after which the Titan first stage is lowered to mated the second stage. At right, the second stage is placed on the first stage after second stage engine has been prepared.

MISSILE ENGINEERING



Atlas Kin. between arms for 17 ft. Titan second stage by its hoist-arms (left). At right, the second stage, still shrouded, is hoisted into the upper end of a gantry cross forward to a horizontal position. Missile is pulled into the gantry by chain.



Fired at Missile Test Center



Completed Titan still has handling stage attached (left). Titan's first stage is ducted by liquid oxygen (center). Unclashed rods are attached; sets JATO bottles which pushed during second stage ahead on early tests. Missile is fired at right.



NEW READER holding Atlas in position without transportation trailer permits faster erection than gentry tower system.

Atlas Ground Support Equipment, Part II:

Integrated Support Expedites Launching

By Richard Sweeney

(This is the second of two articles on Atlas K2M, a major ground support equipment. The first article appeared in last week's issue.)

San Diego—Handling equipment in an essential part of Atlas K2M, ground support equipment, and the transporter trailer is a key element.

Identified generally as a transporter trailer vehicle, this unit also serves as a support tool in missile final assembly and as a hoist on which launchers or test of the missile are assembled for test, inspection and replacement. While the missile is on the trailer, it can go through a systems checkout except for the engine.

Atlas, complete except for engine intake, is hoisted aboard the trailer by overhead crane in the factory and stays aboard the trailer and erected. This is true of both 551 and 552 complexes at Vandenberg AFB, Calif.

While on the trailer, the booster propulsion system and associated hardware which drops away with the booster at booster burnout can be removed to allow maintenance on the missile proper as the booster is a section. The trailer, after carrying the missile from the factory to launching base, also serves as the missile's storage cradle.

When the missile is to be erected, the trailer is backed up to the service tower, and here the attachable rise which help in aligning the trailer with the tower.

Two cables which are attached to a winch well up on the service tower, are hooked to the front of the Atlas trailer and the missile and trailer in a unit are pulled up to erect the missile.

In erection, the trailer serves as a support for the missile. After erection it is lowered and Atlas axis is raised.

When an Atlas is erected at the Vandenberg 552 complex with the new tubular structure erected and some change the transportation trailer is not used during the missile lift. Instead, the true structure of the missile itself, plus the inherent stiffness of the pre-stressed missile shell, provides sufficient structural rigidity.

Point Point

Before erection, the launcher is rotated 90 deg. for attachment to the missile trailer. At the launcher is connected to the missile, the trailer also is connected to a concrete pivot point with the launcher by the trailer. This leaves the missile, trailer and launcher free to rotate about a common pivot point in one structural unit during erection. Control of the operation is maintained through a handle mounted on the launcher.

Due to the nature of the missile's structure, environmental conditions created in launching and the reaction in which Atlas is erected, design criteria for the launcher were stringent.

The launcher is built primarily of large steel tubes. Main missile support is a unit of this same wall panels which fit into sockets on the main and bottom stability. To hold the missile vertical, two support arms are located in a plane perpendicular to the hold-down arms, and these serve to hold the missile within one degree of vertical only as is required to keep stresses low on the missile, rather than as a condition imposed by alignment stresses for launch.

Hold-down arms are kept from swinging by pneumatic cylinders, operating at 5,000 psi which exert thrust of the missile against its base. An over-engineered blowdown system allows the arms to move smoothly when the rocket starts to lift off.

Basic operation of the hold-down arms has the missile firmly held down as booster and initiation engines are lighted off. As all three thrust chambers reach rated takeoff thrust, blowdown is initiated allowing the missile to rise gradually a few inches off the pad, after which the arms swing free and the missile is on its way.

Control aspects of the launching system caused Control to design an elaborate system for raising the blow-down arms and support arms in the total launch sequence system of the missile on the launcher.

For a compact, forward or slight and launch, thrust from the engine exhaust do not engage on the launcher structure and is instead equipment such as fins and rudders. However, should a missile be launched in a way its fins during the first few feet of rise once the exhaust is under power of the launcher. Temperature can reach several thousand degrees Fahrenheit.

In use of equipment, Control has designed the launcher and associated equipment to be able to meet the three temperatures for a few seconds by electrical equipment and part design. The designers also have used shielding to protect various parts and components.

Ground connections to the missile—the umbilicals, pneumatic and hydraulic connections as well as propellant

lines—have been mounted on the launcher and automatically disconnect at launch.

Another function the launcher must fulfill is swinging the missile to erect. When that proper prelaunch loading has been accomplished in the missile launcher for Atlas, seven stress-pipe type units are used. These are the cable connections between the launcher structure and the supporting structure, since tension pins used in erection are removed.

The swinging system is capable of swinging the total missile within 5° of zero weight, which approximately 350,000 lb. of launch. Requirement for close weight determination is due to the accuracy for close in position, needed when the amount of propellant stored when the missile takes off is one of the large effect on range of fuel rockets suspended at launch.

An additional part of the handling equipment, in the missile and development phase of flight test, is the service tower, which is part of the launcher and service building. This tower has platforms at various levels for accomplishing work on the missile prior to launch, as well as serving as the support structure to which existing cables are attached. Also, the tower is a support for using the service vehicle for auxiliary stop the missile prior to flight.

Pre-launch Procedure

Pre-launch activities on the missile are a part of the service tower's function. It is not intended as an environmental protection for the missile, i.e., holding it against light winds etc. In fact in high winds, the tower itself is moved to the ground by cables.

When work involving the tower is completed, the unit is drawn back on to a movable platform which rolls away from the pad. For missile erection, the unit on the station work platform set down up to allow the missile to enter. They show them up for lower removal.

Strategic Air Command has an environmental maintenance concept into which missiles and aircraft are fired, and Atlas is an exception. Maintenance of the long-range missile is set up to fit within the SAC concept, the effort being broken down according to function, level of skill, time and facilities required, as is after SAC maintenance work.

Work on Atlas requires five special tools. Closest is the transportation trailer which serves as the missile's cradle at all times when the missile is not erect.

Maintenance is divided somewhat arbitrarily. Fuel maintenance is a time-sensitive matter, i.e., it can be done in a few minutes, and is a matter of a plug-in or snap-in, it is done on the



INTERNAL penetration provides structural rigidity for Atlas as it is elevated in new service tower, drawing used for support is a transportation trailer. The hydraulically-powered service lifts the missile into place with the nose cone in position. Missile is only for propellant loading. The missile will be lowered after erection is completed (below). All ground connections and umbilicals are attached to missile from launcher.





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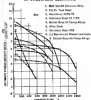
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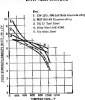
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Titanium taps in Tapco Group's Tools
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Long rolled titanium and barrel view of Molybdenum 6A-4V titanium alloy.



Cross-section view of a rolled titanium 6A-4V titanium alloy tube and cylinder.

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designs a suitable electrical power. As some data, and the power line is a wire wound line can be suitable, but in others it might not. In the area where such power is not available, the facilities design would have to include a generator.

Actual design of the physical facilities is done by others than Conover. Usually an architect-engineer firm has this contract, either as a subcontract or as a separate type contract. In the situation, Conover provides the technical data, such as loads, power required and plumbing, all of which are specific to the missile or design criteria. The architect firm works from these figures.

Conover maintains progress of the design to ensure that there has been proper interpretation of data. Conover also, on occasion, makes changes as required.

During construction, Conover continues to monitor to make sure that there is no deviation from approved plans. While a certain amount of leeway usually is allowed in construction of software connected buildings and facilities, there is no room for that leeway in the design of ballistic missile facilities. This comes under Conover's overall responsibility.

An example of a launch design was the Bane defense which is extremely critical in compliance with its shape, dimensions and location. Nature and function of the equipment is such that either slight dimension changes in location or reference could cause it to be burned into an engine with a single rocket engine hot firing.

Launch Building

Most prominent part of the Atlas facilities, outside of the blockhouse itself is the launch and service building, which also has several other rooms. This is the structure from which the Atlas is fired.

Characteristic feature of the launch and service building is the long ramp on which Atlas is pushed on its trailer to be attached to the launcher. Normally, only a small portion of this building shows above ground, although the ramp extends far above ground level.

Reason why the building protrudes above ground is in the configuration was primarily because the flame deflector must clear away Atlas exhaust at ignition and launch to protect the rest of the building. While the cone might well have been launched from a hot ground pad, it would have been more difficult to design the structure of the facilities and equipment which are installed in the building into such a system.

Structural design of the launch and service building is critical, since loads are involved. These include weight of the loaded missile as well as the outside

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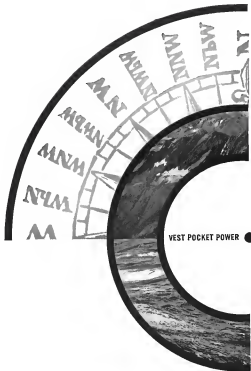
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The Various Dimensions
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be provided.

Other elements in the building include storage rooms for gases such as helium, vacuum equipment and plenty of shelving, outdoor air fans and the taking and power inputs from which the waste is fueled. Also contained in this building are some of the pipes which move the fuel and oxidizer from their respective storage tanks into the engine before launch.

Each installation had the fuel burned some distance from the runway while the engines was in the building. Although the units used at Cape Canaveral were modified according to the research and development mission, the highest safety possible, the 67-1 complex at Vandenberg AFB is a large number

At launch complex 551 the oxidizer tank is hoisted with only a small section showing through an open door. However, all the plumbing and pumps associated with getting the oxidizer from its tank into the nozzle are well within the protected area of the structure. This issue is true for the fuel, although the fuel tank itself is hoisted just outside the pad area.

On the GTI complex, both the oxidizer and fuel trails will be within the loading proper, except for small portions which may extend a few inches beyond the structure limit shell. However, all piping and associated plumbing will be within the structure and well protected during missile launch.

For both the 651 and 652 type rem-
plans, present plans call for three
branch pads per control center. In a
substation, the draw-from-one wire
would again prevail.

This would, of course, be changed if a complete history philosopher were employed.

In designing a complete Affix operational site, facilities are constructed on a per squadron basis, in which a squadron is considered the basic operational unit and the required number of launch complexes is provided for the squadron to get its complement of missiles arm, in that as one of two. Now, many launch complexes are used by a squadron has never been officially counted but it could be estimated from the number of missiles which reportedly have been acknowledged at strength level of a squadron.

Figure most commonly used is 18 minutes per squadron. Under the present operational concept, this most probable would mean that there would be three launch complexes per squadron. This way, there could be up to nine sorties on pads available for launch, with one missile either in maintenance or standby. The time allotted for getting missiles away will be very short, and

change that all that probably will be as those on the pool and inside to go.

Under good conditions, two out of three meals available at each launch complex should be able to fit. Only two launch complexes would be able to fit all nine replicated services are able and could be fit. It is doubtful the 10th missile could ever be able to be launched, since ICBM launch complexes would be, of course, the prime target of enemy ICBMs. From 4 submarine defenses, when they become available, will be used at ICBM launch bases, which is at a still problematical whether the war could extend and for more, whether after the initial launch.

Water is supplied from a tank line to the launch service building to cool the flame diffusers during engine runs. A central pumping and supply system is provided for all three launch/service buildings per complex.

Water is supplied to the launch/service building for other systems such as in case of a bad or sudden spillage. In this case, the standard procedure is to water down the entire facility. Additionally, substantial amounts of water used be available in case of fire, either in the launch before launch, or during a malfunction occurring launch.

Also located in the building is electrical power distribution. Controlled from the blockhouse, this power is used in lighting the missile, and performing the electronics. Outside power is conveyed directly to the missile, prior to disengagement to missile power in sub-belted coils which run from the bracket frame, itself to the missile.

For much of the post-launch activities, the personnel and personnel control center is located in the launch/service building. It is during a launch consideration prior to launch that control is shifted to the blockhouse.

Thrust Absorption

These launch/service buildings have to be constructed to absorb the missile's thrust upward prior to launch. This calls for a launch of burning no ignitions, flame reflectors and transverse vanes, according to the type of use and employment of the launch itself. These design standards have been to extend launch into the ground vertically for a distance, due to that thrust control. Depth is required.

None other for the Atlas weapon system is in the control center, the blockhouse. The blockhouse is a standard concrete structure which is closely controlled for fireproofing and handouts, due to the electronic equipment installed.

Blockhouses at Vandenberg, both 65-1 and 65-2, are sealed after a certain point is reached in conditions. Missiles and launch/service monitoring during

conditions, and systems and thrust buildup prior to launch is accomplished by a closed-circuit television. The same type of closed-circuit system is used to get visual checks on other aspects which are best decided that way rather than trying to see personnel.

Blockhouse distance from launch service buildings is largely controlled by two factors—safety and fire loss from the need to control center. Safety, due to its content, be extremely fire, and more concrete and reinforced steel to the launch distance of the blockhouse. However, fire loss can be a serious factor in that situation, more extensive security measures are required to ensure that the missile and its system are being properly actuated, increased and performing within intended limits prior to launching.

Backup Missile

At Vandenberg, missile storage area for complexes 65-1 and 2 is a separate maintenance area. First, missiles are kept in the launch status, while being worked on in maintenance as well. Those missiles which cannot figure in operational plans, or those to be fired in which are being used in firing exercises, just to firing, remain in the pool itself.

Under the former concept of 65-1, the missile is left erect. Whether position is finalized by the gassy staff, be direct missile attachments to it, and by orbital predictive coverage.

In complex 65-2, the missile remains horizontal, resting on its transporter trailer, and with the entire structure over it. Cannot at a major overhaul can be there is over the structure structure to provide protection for the missile in this condition.

In support of its Atlas program, Convair has set up what is a design program to be for computer service, design product support. This has been noted in the Convair Administration organization, and is divided into five subordinates activities. These are fire and control service, support center, and base activation.

Planning Divisions

Under support planning and control are divisions for planning and control, e.g., test control support data system. Functions of this group is to do the advanced planning and thinking to assist in key Convair's Atlas weapon system support program, functioning alongside both base and according to requirements.

Support activities that is composed of engineering, publications, logistics and documentation. This unit takes care of the engineering required, much of the administrative effort involved in the support effort as well as doing most of the paper work required, plus such work

as publications and documentation.

The support center unit is where much of the actual activities takes place. The supply unit, quality control, manufacturing control, and support, control functions have. Support quality control, largely functions to assure that transfer items and subcontracting equipment and components meet all specifications. Manufacturing control makes sure that all Convair inside parts, components and subassemblies meet specifications in all areas.

The support center also performs actual manufacturing, manufacturing, repair, and other efforts required in production type efforts in the case of support work.

A new activity has been brought into Convair's product support program, in the base activation unit.

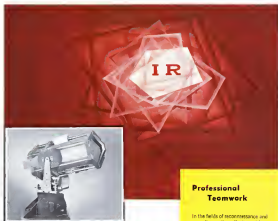
The base activation unit functions under Convair's contract to test that the Atlas weapon system is delivered to the Air Force, and turned over to the user agency under the agreement. These can get its technical knowledge via training the weapon system's various elements to work, in order to adequately provide the base with the required installations to make the weapon system operational.

Field Activity

In the early research and development work on Atlas, considerable field activity was carried out by engineers. As the weapon system moves operational status, this must be shifted to Air Force SAC personnel. These technicians have considerably different experience than those who have concerned with the research and development effort. Also, the field is large now to all except a small group at Ballistic Missile Division of Air Research and Development Command.

As a result, the Convair experience is to deliver to SAC a base which is best not for operational activity with the Atlas weapon system. Under the base activation unit, these are then, however, there are support activities, and just at Vandenberg AFB, and base managers being trained for their base to be set up.

In setting up its product support program, Convair did had to develop the proper method to approach the problem. After this had been accomplished, the company realized that its primary function was as an integrating contractor at the time. Which means that the work is done by other companies, either under contract to Ballistic Missile Division Group of Engineers, as to Convair, it still remains for Astronautics Division to make sure that everything is done and is verifiable under the operational concept to be employed when the user agency assumes control of the base.



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DORNIER Do 28 Lycoming engines are mounted in fairings by stub wings; one section possibly could be modified for rotor.

Germans Show New Planes at Hanover

By Edith Walcott

Heaven-Lock of hands is search happening German zero club development and lightplane design. This was the overriding impression of Germany's first postwar air show held here.

It was emphasized further by the appearance of only one new German design out of a total of seven already seen at last year's Hanover show. This was the Bessard SK 95, a two-seat subsonic low-wing lightplane with propeller mounted behind the tail.

During the show, Dornier announced a market version of the single-engine

Do-77 series, the Do-78. Recently the same plane, it is powered with two Lycoming engines and has improved VLO and STOL characteristics. It will be tested at this year's International Air Show at Fries in June.

Apart from Dornier's Do-77 which, as last year, was receiving a shabby service for visitors from the air show to the Hanover Fair proper German airplanes displayed and flew in demonstrations.

• Bessard SK 95, designed by Alfons Pötter of Alfons Pötter & Co. Bonn, who also designed the Fisher G. Segel of Götting, an experimental engineering

office, collaborated with Pötter in the construction of the interior of this two-seat model. Two seats of the Bessard are planned one with a Porsche 605/1 55-hp engine, the other with a Continental C40-114 55-hp engine. The latter will have enough power reserve to enable the SK 95 to be used for glider towing. The aircraft has now reached its flight test stage.

• Klemm Ki 1078. Its designer, Klaus Klemm, Götting, Böhlingen have recently succeeded in selling one in Sweden. The firm considers this first postwar sale to the Swedish market very promising, because between 1939 and



BESSARD SK 95 two-seat lightplane has the propeller mounted behind the tail section. Aircraft has reached flight test stage.

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Because of its exceptional performance, range, operation and maintenance economy—and its adaptability as a light cargo carrier—Cessna U-28's are being used extensively for administration transportation and in support missions throughout the Air Force.

DOHMBB Do 28 research aircraft will be used as a force tested to study VTOL and STOL problems in Germany.

Munch-Gerrens never made use of the misinterpreted Do-29 during her trial, was depicted as a joint effort by Danner and the Deutsche Versuchsanstalt für Luftfahrt (DVL), and was removed by the German Defense Ministry.

Munich—Germany's newest aircraft, the twin-engine Dornier Do-27 being tested, was developed as a joint effort by Dornier and the Deutsche Versuchsanstalt für Luftfahrt (DVL) and was financed by the German Defense Ministry.

latory forces caused by the tip contact from the procelleron.

Vertical tail has increased area and height compared to that of the Do-27, and a dorsal fin has been added. Additional rudder area has been provided for low-speed control.

Cockpit has been built around a single robot and is equipped with a

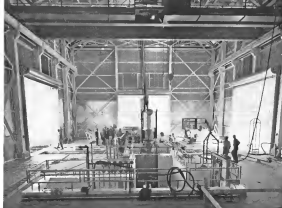
Martin-Bulley type ejection seat. Landing gear looks like the standard Do-17 installation with additional drag and sub-seat links. Tail wheel is conventional.

Plane was first flown last year in December, says the company, and it will be used in an extensive flight test program of VIGL and STOL problems. No production of the plane is planned and Dornier explains that the aircraft is really a test vehicle.

[illegible]

Journal of Management Education 32(10) 1039-1050

[illegible]



INTERIOR of the Georgia Nuclear Laboratory reactor building is shown during the reactor shutdown. The concrete pit below the shield with water below the reactor was critical. After tests have been completed, the reactor is lowered by lowering it into the pool. The reactor building is largely identical to that of "reactor" quickly and may be returned relatively soon after a test.

Tests Simulate Nuclear Flight Environment

By J. S. Bates, Jr.

Demonstrating the effect of U. S. testing of large submersible for a nuclear-powered aircraft carrier, operational capabilities will begin early this month at the Georgia Nuclear Laboratory operated for the Air Force by the Georgia Division of Lockheed Aircraft Corp.

At this new facility, it is possible to simultaneously subject an entire load of equipment—landing gear, control and communications systems, etc.—to nuclear radiation while the equipment is operating as it would in flight. Airframe conditions, high and low temperatures, vibration, humidity, ozone atmosphere and other aspects of the flight environment can be simulated by placing the test vehicle in aluminum pressure vessels as they are cycled through the sequences required during an operational lifetime.

A completely new dimension in radiation testing will be opened by this laboratory, designated Air Force Flight 47, because in the past, materials and equipment have had to be tested in small specimens that could



LARGE PIPES which supply coolant water to the large sodium effects system are shown with the reactor in the "up" position. The flexible joints which allow the pipes to follow the movements of the reactor are in the lower portions of the photo. Flexible water is used in the pit as well as the coolant. Grated expansion reactor (right) is used for low power experiments and to eliminate fuel elements for the large sodium effects reactor used to simulate aircraft systems while they are in operation.



be placed inside a reactor and it has not been possible to simulate carrier aircraft at sea. Very little data on the effect of radiation on aircraft systems during operation is available through direct testing because of the strict non-flight conditions which are precluded until now.

Therefore, radiation testing to date has confined around small components of large systems and appearance of basic materials. It has been possible, with the use of data to determine the feasibility of using carrier systems in a nuclear

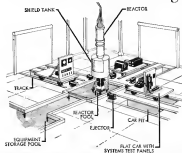
powered aircraft. However, going beyond the proof of feasibility to the problem of designing the most efficient system for nuclear carrier aircraft will require large amounts of detailed data such as that which can be supplied by the laboratory at Decatur.

The Georgia Nuclear Laboratory came into being after Lockheed secured an Air Force contract for the design, construction and operation of such a facility. A single group under Dr. J. C. Flock and Dr. Maurice Miller has been

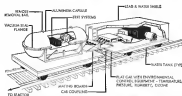
in charge of the laboratory through all three of these phases.

It is located on 11,479 acres of wooded, hilly ground in an isolated section of Decatur County about 50 mi. north of Atlanta. This remote location was chosen because of the initial decision to use a 10 megawatt reactor with collection shielding, those portions of the reactor are shielded and some are not above ground to radiate the test specimens.

Personnel who control the reactor and the tests are housed underground.



REACTOR is shown out of its pool, with three aircraft systems on fixtures in test positions. The crew handling the test is in a hatched concrete building about 10 ft. away.



CONCEPTUAL DRAWING of a test vehicle mounted inside an aircraft chamber on a flat car is at left. This chamber is made of aluminum so that it will not disturb the test field in any given extent. Power on board is heavily shielded. Shaking of the test car (right) needed for deserting and impacting outside thus has been simulated in used for a clear rehearsal before the test to make certain that all necessary work can be done smoothly. It takes about a year of more study practice for a man to become expert with manipulations.





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PRODUCTION BALL BEARINGS

to reinforced concrete buildings. The swastika of the buildings are located at least 8,000 ft from the test area and the reactor so that people may work in their usual normal conditions.

The decision to clear a large area around the reactor and use chlorine as a solution shielded away large areas of concern as compared with the absolute construction plan of housing the reactor and large production area is a heavily shielded building. The most element of the stage, however, is difficult to determine, since the configuration of the laboratory had changed to a number of years from the original plan.

A primary advantage of the present shielding configuration in the annual accessibility to the laboratory was after reactor operation. This is a feature not easily obtained in a heavily shielded building because higher radioactive and remains as for a long period.

Usefulness of the present laboratory extends well beyond the nuclear aircraft program. Swastika in all types of nuclear engines for aerial and space use can be tested at Downsfield during their development. All types of nuclear powerplants, regardless of how heavily they are shielded, have some similarities which must operate in radiation fields and could be tested in advantage at Downsfield. Most test work, however, probably will be conducted with vehicles that fit and carry desired or shadow shields for the reactor.

Commercial Inquiry

Almost 180 companies have been supplied with detailed data on the facilities at GNL and about 90 of these have made inquiries concerning the testing of specific systems. Many of these requests concerned commercial nuclear equipment. Arrangement of testing facilities is a responsibility of the Air Force, and it is probable that the bulk of the tests during the next few years will involve military equipment as the development of nuclear armaments, rockets and other flight vehicles is accelerated.

Expansion of GNL is feasible because of the large amount of unused land at the facility. There is room to construct above ground test buildings for nuclear powerplants or shielded areas, upon using the principle of shielding with distance. Such test units could be supported by the shops and facilities now existing at the laboratory.

A new test reactor also is serving consideration in tentative expansion planning. This reactor would be of the pulse type that would allow a much greater range of radioactive exposure rates using both and flux densities several orders of magnitude higher than now possible.

The present Radiation Effects Reactor is similar to the other test re-

actor now in use and does not have the rapid power change characteristics of either the pulse reactor or some of the systems being developed for flight purposes.

The current reactor can alter its capacity to maintain rates from 2.1/2 to 14/1 to simulate various operating conditions and can reproduce the radiation fields of steady state light.

The extreme facilities required to rapidly handle a large number of radiation tests is probably best explained by following a typical test through GNL. The test test starts in an ARC-34 ultra high frequency communication room and the second will be an electro-hydraulic system using loading gas components. These test units have a twofold purpose. They will provide useful radiation on the test specimens and also will give the operating crew their first "air" exposure at the new facility other than the calibration of the test area and fields that has been in progress since the reactor first went critical last Dec. 34.

The first two tests are completely internal projects at the laboratory. Most of the tests to follow will be performed at the request of some outside contractor, including other Lockheed divisions. The system to undergo evaluation probably will be supplied by the company during time at GNL.

Any modifications in the test system necessary to accommodate instrumentation and power supply facilities at GNL and to make sure that reactor disassembly is possible will be worked out between laboratory personnel and the contractor. Modifications agreed upon should be accomplished either in shops at GNL or else at the contractor's plant.

When the test system is delivered to Downsfield, it goes to the Radiation Effects Laboratory and is mounted on standard page flat cars with 10 x 15 ft. beds made of aluminum and filled with water. This type bed helps to shield the steel wheels, springs, etc. of the car's running gear and the materials of the infrastructure "standing base" which remain radioactive for some time after being irradiated.

Conceptual plans have been drafted for constructing passive vessels and other environmental chambers to house the test system during irradiation. Exact design of these chambers will depend upon the type system under test. No attempt to design large environmental chambers will be made until experience shows exactly what will be necessary to handle a major percentage of aircraft takeovers.

One primary design point concerning all of these environmental chambers is that they will be constructed of aluminum, which is not greatly affected by radiation. This metal has a low capture cross-section; it does not detect the flux field to any great extent and it also has a minimum "cooling" period after irradiation before it can be repositioned safely.

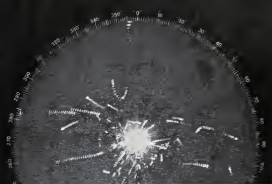
Overseas Rehearsal

Once the test system has been mounted on the reactor or cars, a complete dress rehearsal is held in an effort to make sure that all instrumentation and remote control devices function properly. Rehearsal demonstrates if the system is checked in a mockup of the heavily shielded "test" unit in which the system will be supported after irradiation has been completed.

Each test system probably will ac-



REACTOR BUILDING is in the center of the site area. The railroad used for transporting test equipment branches into six tracks that lead to the six positions close to the reactor. Reactor building is 8,000 ft from the nearest unshielded and unshielded building.



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quest some special tools for the unique function to accomplish this remote-controlled mission. An indication of the magnitude of the remote handling problem is that it takes approximately one year of a life daily practice to qualify a crew in an expert with a manipulator system disconnected with compensation is not appreciably longer, however, than under direct control conditions if the manipulator operator is an expert and has positioned a few times with the control in question.

After the operators of the test system and its manipulators have been double-checked, it is ready to be transferred to the reactor site. An unattended manual locomotive is used to make the transfer of the "cold" test article. For "hot" work, special care is taken between the operator's locomotive and the test unit. It is about 1.5 m along the track from the Radiation Effects Laboratory to the reactor building. The test cannot pass through a limit 1,600 ft from the reactor until a number of checks are made to see if the manual solution from the previous test is low enough for the train's crew to approach the reactor building for a test period.

Once this has been established, the test unit is pushed into position where it is automatically locked in.

All instrumentation and power leads from the test system on the data are brought to a board underneath the air. This board mates with a similar board between the tracks as the air is filled into position. This is the only connection necessary to tie the air into the data gathering and control system in the underground buildings which house the test personnel.

Reactor Ruled

"The radiation begins after the proper conditions have been established in the environmental chamber housing the test system. The hydrogenous, water-moderated and cooled reactor is moved out of the large pool of water which shields it between tests and is brought to the proper power level. Some tests conducted at the beginning of an experiment last only a few minutes and some will continue for weeks depending upon the reaction analyzed. Nondestructive analysis will be employed for cautious testing up to one week under power. For fine tests,

these are no sections for test run around the reactor pool which provide a total radiation volume of about 5,000 cu ft and an exposed board area of about 400 sq ft. Two methods are available to control the amount of radiation the test system on the control station receive. First, the position of the system on the test can may be varied by the length of the test—about 15 ft maximum in the building, but because the cooling period for the test system

approach closer to the reactor. Second, the reactor is surrounded by a track divided into sections, and this track may be manually filled with water and cleaned. This is best to say the gamma-neutron ratio.

Part of this shield tank may be removed for special tests and equipped with an environmental chamber for small test articles. Safety measures employed during the test include an automatic system to "freeze" the reactor so that it does not heat it into its point of shutdown. Water should there be a sudden loss, perhaps due to the reactor, a failure of the main power system which would stop the mechanism maintaining the reactor's performance, a sudden failure of the water circulation system or a loss of coolant flow—no short, if there is any failure of a system connected with the reactor.

'Sensors' System

The automatic "sensors" system is built around an electromagnet which holds the control rods out at the reactor. Power to this magnet is cut as soon as any of the three instruments show and the control rods are moved by their own weight into the reactor. Gravity then forces the reactor to the bottom of its shield pool. An emergency flow of cooling water to take the shield from the reactor is assumed from a large tank of water located on a lift half above the reactor. This tank drains through the reactor into another tank set in the shielded box of the reactor building.

Present plans are to keep one running to the laboratory on a three-shift basis. Each shift will consist of an hours of instrumentation and reactor operators and two hours with the reactor "secured" to change shifts and check equipment in the underground experimental building.

Changing of guards for each shift takes place above the ground with the distance that the crew can keep between shield and the reactor building and the type of system which has been under development at the beginning of an experiment. The amount of the distance from the source. Some of the systems which will be installed will become very radioactive and cannot be approached for over 180 ft, while some will cool down enough within an hour.

Plutonium with the test system should be automatically ejected from the water building, and they will roll downhill for a 1,000 ft in excess. The locomotive and test system can then be moved up the track to a remote location for cooling. Plutonium was in the reactor building for test is then a system of low radioactive the other test system in the building, but because the cooling period for the test system

can be brought in many times into several days or only left in its house.

Post-test inspection and disassembly takes place in the "hot" cells of the Radiation Effects Laboratory where the test system fixtures are taken after spending a time in the cooling area. There are four of these cells. The first is used occasionally for major disassembly of the test articles, and the others are employed for making more detailed inspections of radiation damage. Four well-mounted manipulators are provided in each cell and one large overhead manipulator can be used in the first two cells. An overhead crane of 15 ton capacity is available for all four cells.

Observation of motion in the cells is through windows, periscopes and closed-circuit television. Events and instrumentation leads are available so that the test system may be run in the "hot" cells. Each post-test running diminishes the extent of the recovery step of the system compared to if they failed during the shutdown.

When the radiation level of the very hot parts of the test system have dropped low enough, they are taken into "warm" laboratories where they are inspected and tested for brief periods by laboratory personnel.

Operation of the GNL testing facilities is presently divided between three groups. One group has charge of the test system. One is concerned with the safe operation of the reactor and the third is responsible for making nuclear measurements in the test area and the reactor building facility. These three groups assist in the test work in other groups which study methods by which the operation of the laboratory is a whole might be improved.

Needed Service

One of the services needed at the laboratory is a very accurate forecast of the local weather conditions. The reactor is located in a slight buffer, and it cannot be operated if there is a severe temperature extremes below 300 ft which would result in too gaseous radiation products. A temperature forecasting system has been developed which can forecast temperatures up to 100 ft to ± 0.5 deg. for a 24 hr period. Instrumentation used for this prediction is a 150-ft tower with four pentameters and a one-inch steel wind gauge at three feet. This system has been in operation for three years.

Background radiation levels in the atmosphere and in the soil and water around the facility also have been measured. This data may be used in the future so that it will be possible to accurately determine just what changes take place. An extensive system of monitoring these changes has been designed at GNL, and it is one of the elaborate safety precautions in operation there.



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Horizontal Situation Indicator

Horizontal Situation Indicator, developed by Collins Radio Co. for Air Force integrated instrument panel, combines information formerly displayed on several indicators in a single forward instrument. New instrument displays aircraft heading, selected heading, heading error, bearing and distance to known facilities, destination, target air support and the assignment or computed course and course deviation, the direction of travel along the course and the mode of operation being displayed. Instrument development was sponsored by Wright Air Development Center's Flight Control Laboratory.

ols that now rely upon radio control, John A. Moore told Navors. Moore is vice president and general manager of North American's Avionics Division.

Now an issue of the new aerial guidance: sophisticated suggested by Moore.

- **Interceptors**, outfitted with inertial guidance, would not need to be on target, guided by SAGE computers in this task to the targets of the target where their own airborne radar can take over. Instead, it would only be necessary to transmit a brief message to each interceptor, giving the location of its target, after which the inertial system could navigate the interceptors to the target. Up-to-date information on target information could be periodically transmitted to the interceptors. This, Moore said, could reduce the assigned target tracking demand of SAGE computers and their associated data link facilities.

- **Auto-tar** mainly, outfitted with a small inertial system, could navigate along a predetermined flight path to the target impact point, set in past prior to launch, requiring only occasional signal inputs from the interceptors to update information on target position. Inertial guidance could also be used by surface-to-air missiles in similar manner, greatly increasing the effective capacity of the ground-based guidance system.

Results of a comparative analysis of

all available long-range communications techniques including satellites in terms of range, capacity, reliability, and cost was reported by W. E. Moore, Jr., of Lincoln Laboratories. Included in the analysis were ground wave, ionospheric reflection, submarine cable, microwave link, tropospheric scatter, ionospheric scatter, satellite beam, and satellite relay and two types of passive satellites.

Transmission cost figures, which Moore emphasizes are only approximate, were calculated on a cost per bit basis. This is equal to overall equipment depreciation and maintenance cost divided by the product of system capacity in bits per year and the system operating range.

Satellite Relay

Design parameters for an active real-time satellite relay, employing frequency shift keying (FSK) and frequency modulation, was described by Felix K. Webb of General Electric's Light-Motion Electronics Department.

If the satellite incorporates means for stabilizing its attitude relative to the earth, it should be possible to use a small, simple inertial system which will provide desired course guidance, not set by large enough to shield solar cells from the sun. Webb said. Based on operating at 100 cps, and a ground receiver time figure of 0.5 db, Webb said that a satellite transmitter power of 10 watts should provide a 75 db. margin over threshold signal level.

Utilization of transistors and other solid-state devices is fast approaching the point where practically all avionics equipment will use solid-state devices for power stages of less than one volt and frequencies under 100 mc, Maj. Gen. M. C. Dunder, USAF Director of Research & Development, told Navors. The solid-state device probably will be extended to all avionics equipment in the range below 1,000 mc, and 0.2 watt as the future, he predicted.

Decreasing the objectives of AIRDC's new program in microwave electronics (ENR April 27, p. 34), Dunder said that Air Force hopes to reduce use of an infrared target seeker from the present 5 in. x 16 in. dimensions to only 5 in. x 2 in. through application of microelectronics.

Dunder said that AIRDC headquarters is investigating the possibility of a sophisticated means of apportioning which would enable each AIRDC center to report changes in status of each of its programs, including of new work, completion of old work and other important information less than 24 hr after the action has taken place.

Dr. J. W. Herold, vice president for research at Westinghouse Electric, suggested that the military services may be entering an era of progress that will be revolutionary in its own. "The Westinghouse official said that defense contractors are accustomed to being told what to build, how to build it, and when to build it with, but now they are being told what requirements there are, they must have to perform the job."

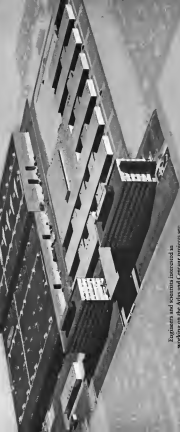
In fact, Herold said, "some have been told that they will not be considered as acceptable bidders unless they have an organization which is like the usual. To such into the contractor's organization and no one shall report to whom what kinds must appear on the organization chart, what files must appear in the folder, a contract, to the best interests of the government." Herold said each bidder should be allowed to organize in the manner which best enables him to do the job. The important systems should be in time, low cost performance, he explained.

Highlights from some of the other technical reports presented at this year's Navors conference include:

- **Area Digital Display Spectroscopy (ADDS)** which would determine radial velocity of a space vehicle with respect to a star or to the sun by means of an optical-electronic system which measures Doppler shift in wavelengths of star sunlight, was described by John E. Moore-Kremer Co.

- **Reduced ionospheric signal returns**, showed on a ground surface, which produces unidirectional, circularly polarized, single lobe radiation patterns over

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GENERAL ELECTRIC

Fellow Engineers and Scientists

My company has asked me to tell you of the unusual opportunities in operations research at System Development Corporation. These range from positions for engineers and scientists who would like to develop their skills working in a team under an experienced leader to opportunities for those who are looking for positions of leadership. I hope that the following account of our work will lead you to inquire for further information.

Briefly, SDC's business is automated decision-making systems. More fully, we develop large scale, computer-based information processing systems in which the computer is used as an on-line, mathematical control element for a system operating in real-time. At this stage of the art these systems are semi-automatic, the man-machine team in which man shares the expensive control function with the computer. Our work at concept oriented, rather than hardware oriented, and deals with problems of overall system design, data processing development, and man-machine system training.

The most fully developed large-scale semi-automatic system is the SADE (Semi-Automatic Directed Environment) Air Defense System. We have a major responsibility in the development of SADE. Our experience and unique team skills have led to diversification of our activities. We now have important contracts for other major military and government systems used in our country. The demand for our services is reflected in our growth from 10 to more than 2,000 employees since 1960, and the increasing probabilities of excellent development opportunities for us in the future.

In this brief message, I can only suggest the variety of operations research problems in SDC. Perhaps the most important point is that this variety is limited only by the imagination and initiative of our staff.

Some examples of areas of work are: (1) allocation of decision-making functions between man and machine for optimal system performance; (2) measurement of system capacity and system performance; (3) evaluation and evaluation of design changes by operational means; (4) quality control and testing of operational computer programs; (5) allocation of computer capacity among several system functions; (6) scheduling and control of production of operational computer programs; (7) optimal assignment of mixed weapons to targets.

SDC recognizes the importance of a well planned research program for the stability and future of the company, and we are carefully organized to carry out such a program. The following are some areas our operations research people are involved in: (1) simulation and operational testing techniques in problems of control systems; (2) information retrieval and theory of information processing; (3) medical data processing; (4) advanced techniques for computer programming; (5) logistics. We have unusual facilities for research at SDC—these include one of the largest computer facilities in the world and outstanding simulation laboratories.

We have given considerable thought to organizing the activities at SDC to provide for professional development and self expression. Specific research professionals are carefully assigned so that their individual talents are matched with company needs. These assignments are reviewed regularly to make sure that developing talents are directed into new company opportunities. We regard the effectiveness of research studies and performance of professional scientists as indicators important to the company. We encourage new ideas and provide the time and means to explore them.

SDC is one of the leaders in a field which will have a remarkable technological and scientific development. It is a new and vigorous company with a bright future. I encourage you to join us.

Please write Mr. R. W. Frost at the address below if you wish to pursue this invitation.

William Kozuch

William Kozuch
Assistant Director for Research
Operations and Management Research
System Development Corporation

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LETTERS

Eastern Strike

[illegible]

In closing I would like to make a specific reference to a statement by Mr. Lutz in his article, entitled "U.S. Aid to Asia: The Fiscal Challenge" (AW May 4, p. 26) quite honestly reported a \$7.3 million profit for the period directly a few months previous from a single pilot study in the end of the year.¹ Careful investigation will reveal that since in the matter of Eastern Air Lines has there been a disruption of service by the pilots. I'm sure we will agree with me that even such a fine study, and its continuation.

Call W. Fries
Fries Eastern Air Lines
Sydney, N. Y.
(Please Print or Stamp Strips against
Eastern Air Lines as taken by International
Association of Mathematicians and Flight Engineers
over International Air-ways.)

Satellite Relay Credit

Two good items of the Oct. 30 issue of your excellent magazine, and would like to recommend on a week at Flit-King's airport. "TISNT" Program: Solitaire, Rules: Station 1 to 30.

The John Farnham would, I am sure, be the first to repudiate the statement that he was one of the first to study and suggest the feasibility of satellite pulse stations— nearly four years ago. To the best of my knowledge, this suggestion was put forward 14 years ago in Windsor Mass. The suggestion was further discussed in later sessions. Flight (1950) and reached a very early synthesis, as The Exploration of Space (1944).

If there is any carbon reference in the show, I would be extremely interested to know it. And I'm sure John won't mind us quibbling after all our last book was dedicated to him.

ALBERT C. CLARK
Glenn Wilton Associates
Colorado, U.S.A.

(Dr. Perry agrees that Mr. Clarke suggested feasibility of valuable communications with student study, free from price to his own paper on the subject, and regrets that he failed to credit Mr. Clarke in his paper—Ed.)

Anonymous Work welcomes the opinions of its readers on the issues raised in its magazine's editorial columns. Address letters to the Editor, *Anonymous Work*, 320 W. 42nd St., New York 36, N. Y. Try to keep letters under 200 words and give a genuine identification. We will not publish anonymous letters. All names and letters will be withheld on request.

Navaid Controversy

In regard to the Doona VOR controversy it seems to me that an ideal solution to the problem is to combine the advantages of both systems into one new thing: to give the VOR system of ground transmission in conjunction with the Doona using small type of positive presentation. Such a plan would not only give us a modern version of radio but to strengthen her could also spite the financial pit between both sides.

NOV. 1974
Chloe, Va.

Lear Contracts

Ent. Inc. has the responsibility for developing and manufacturing the primary processing reference system for both the river and Nile Zebra. I mention this in connection with the manufacturing public in-

There was no technical reason why, under the heading of Goodness, mention of Lenin's contribution to these minor progress was not made, but just for the second and the year intelligence, Alex almost 87 000 000 in constant growth in Russia, and actually, while more than this on American, have to be taken account by one Carol Raphael Newman.

R. V. DEERAN
Marketing Manager
Muscle Products
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Safety at Midway

The recent accident to the *Comcast* freighter at Malindi, with the presidential outrage of the crew without access, might prove to be a well-disguised blessing in disguise. In a recent issue (*NW Feb. 5, 1990, p. 118*) I noted that formation of marine operations from Malindi to Zanzibar has expanded to view of the lucrative efforts of *Comcast* drivers, considered in past efforts unsuccessful or unconvincing their speed, upon a major portion of our national trade.

Since that time the only tangible change has been the institution of a large expansion project for the hotel, after real-estate mogul handling facilities at Midway. Possibly there are unpublicized economic factors that justify the expansion, but it is hard to reconcile a risk a company (and hotel) at which co-owners. Midway is not a dangerous airport, any more than O'Hare is an oil-rich, cash-strapped, or even a "lame" airport.

63 mph is primarily safe. However, product designers that in the interests of sensibility, or adequate safety record, use does not use excessively push very heavily in its operating limits. Perhaps you should consider repeating of the findings of the Carver accident will avoid the extremely self-evident fact that we are neglecting or defining a new

that would significantly increase the effectiveness of Chinese operations when, among the possibilities, and/or predictability of the inner flighted West and East.

to enhance output in a vital area by spreading transactions to a better facility where one is mandatory for the increasing volume of commercial jet aircraft operations.

'Fixed Base'

I read with interest and gratification your editorial in *Quarrier's Weekly* for April 4 regarding the growth of human feces. For those of us in the business, such recognition is certainly appreciated.

However, I noted the use of a term "fixed base operators" which has been used by other publications many times in critical form. I think it is all wrong the speaker. This designation is justified for aircraft and some operators the women we have with respond that aviation because of us.

In the long-dented past systems were made barometers who turned the corner as for business. Eventually some of these either got tired and drifted down, or felt they could make a living from one aspect. Thus, because "hard work" is needed in some others who still persevered.

That makes the term "hard hat" a reasonable and appropriate and outdoor work so dignified to the status of the up-and-coming enter and service operators. Really, just like a real "hard hat".

Please don't take this as any special endorsement of any particular overhead projector and/or any one publication. It is simply an example of the computer I have had on the store to try, to bring about any self-organization and correct technology for the modern "labor and service economies."



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Origination of high temperature fluorescently tagged assemblies

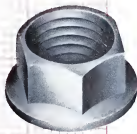
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gives the design decision to the engineer

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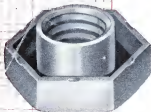


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NAS679	.9	1.7	2.4	2.6	4.6	8.6	140,000 psi
AN365	1.4	2.6	4.2	5.0	9.0	18.0	140,000 psi

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